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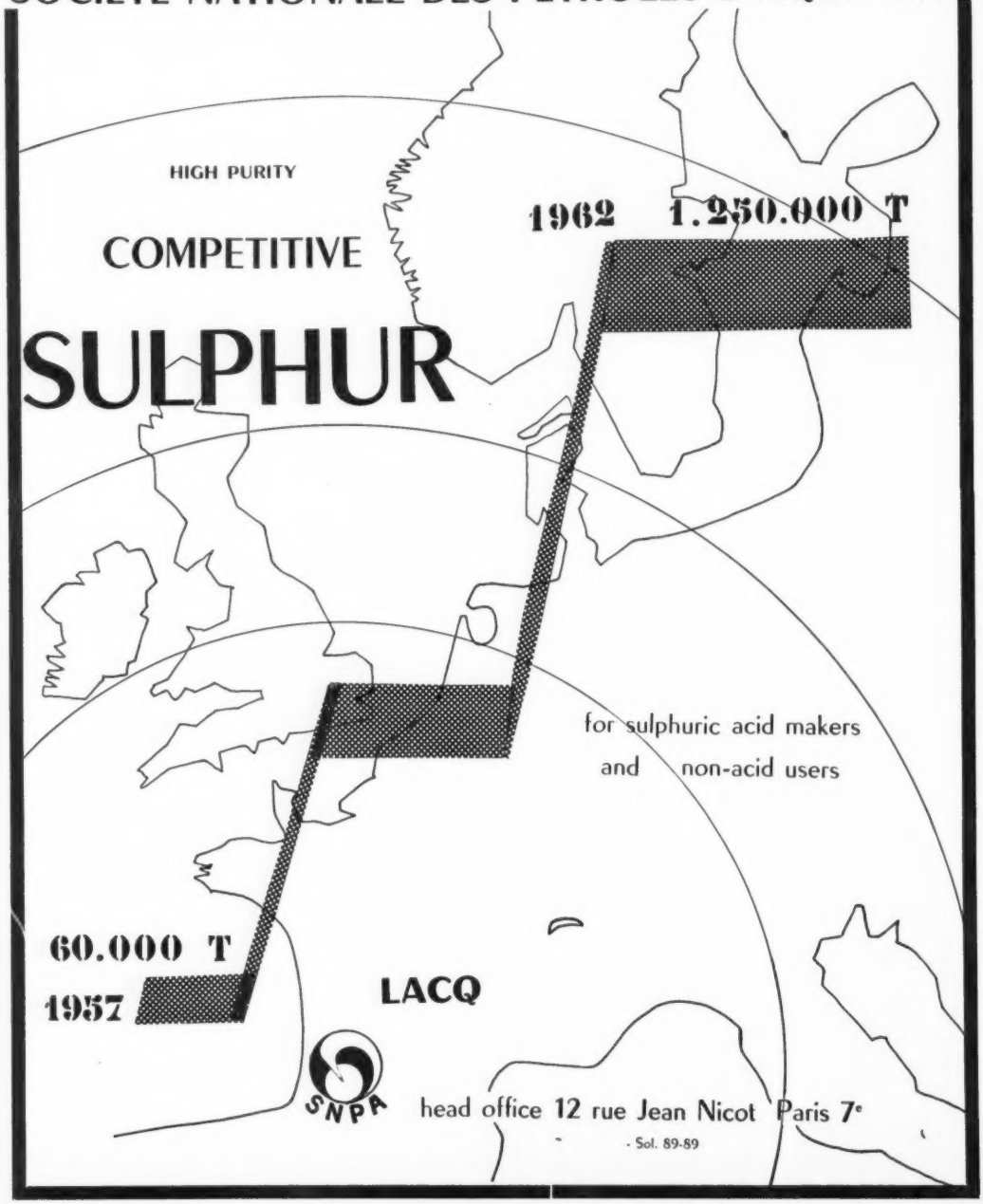

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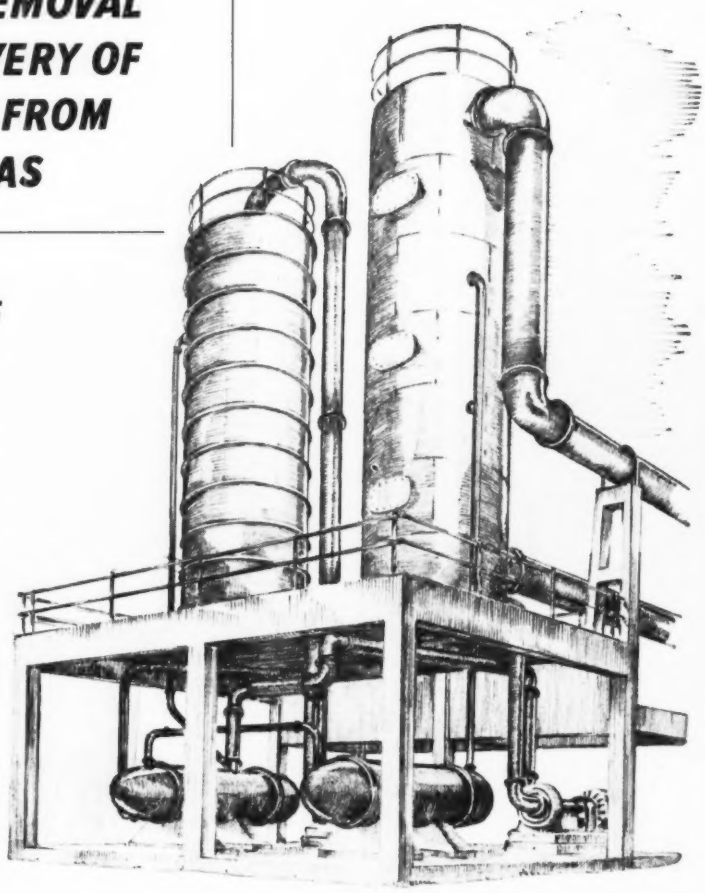

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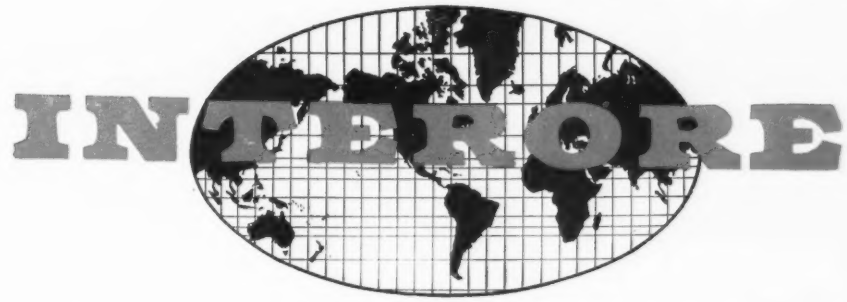

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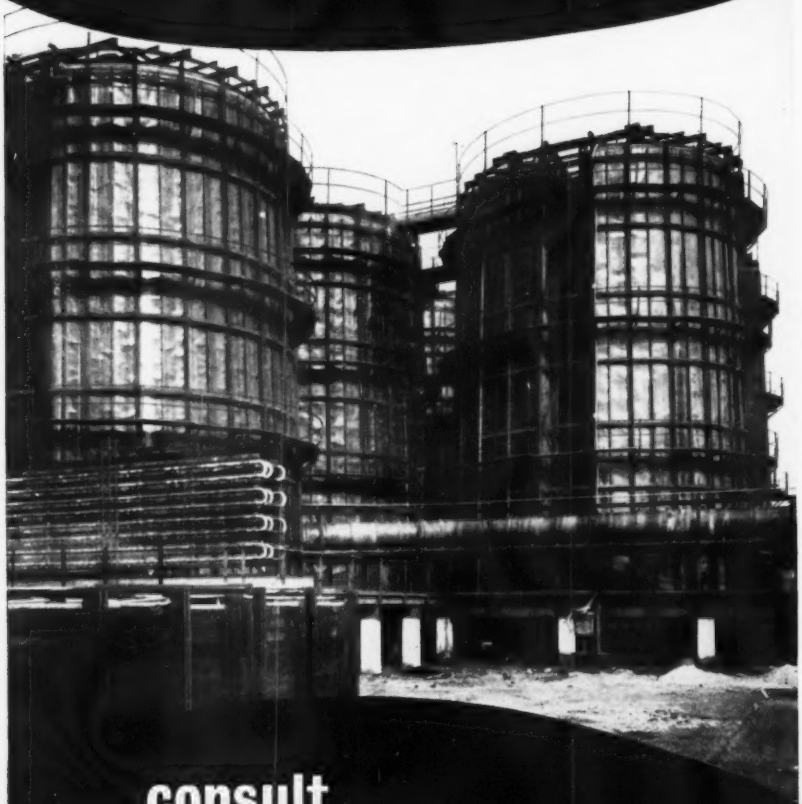

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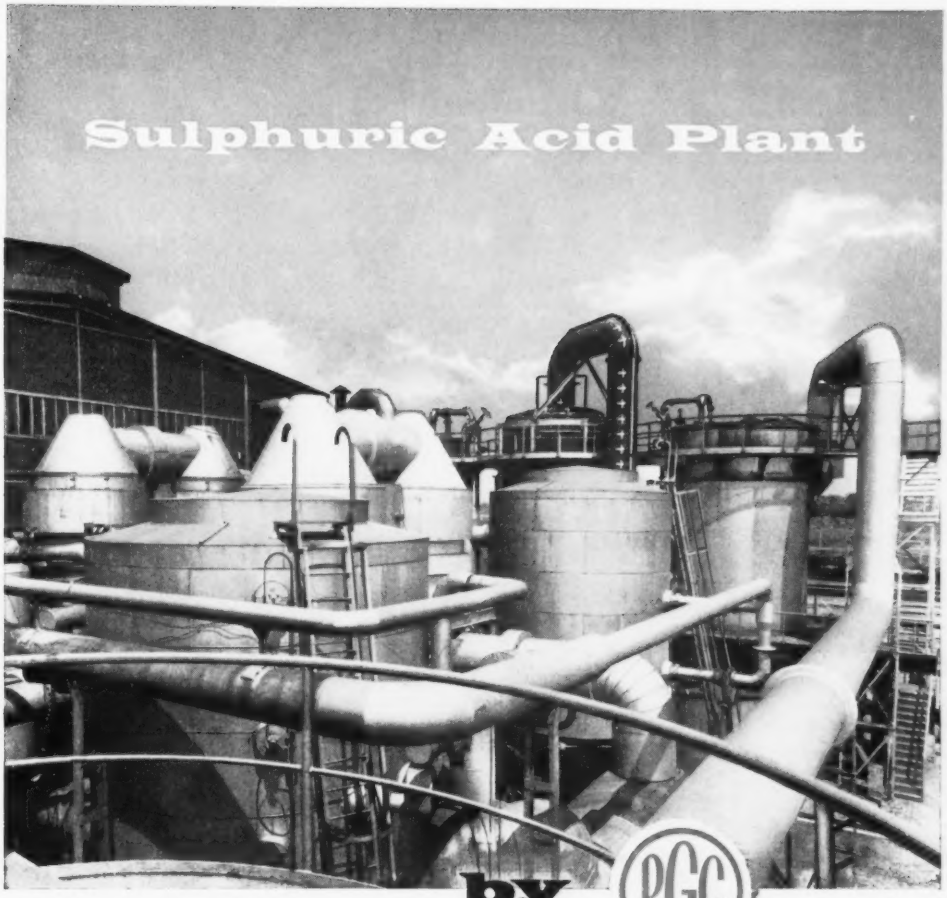

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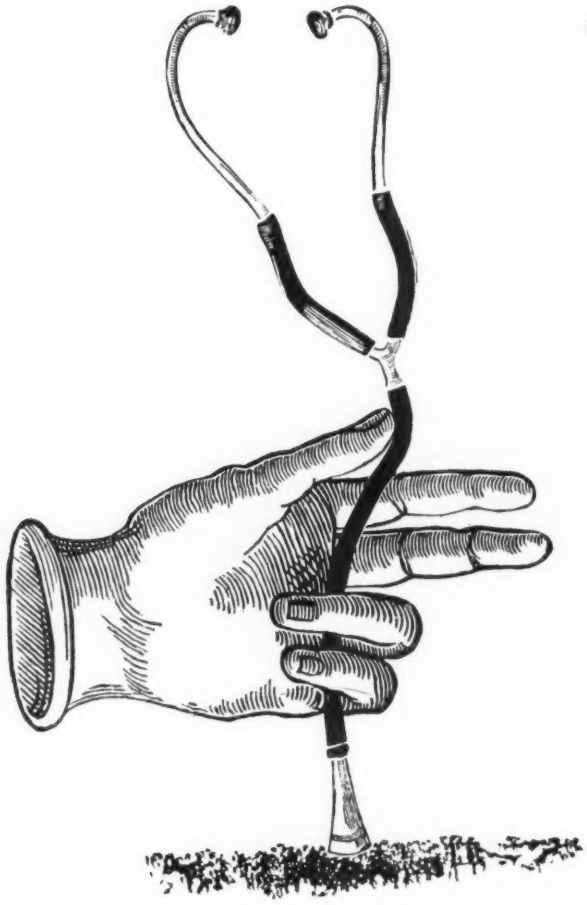

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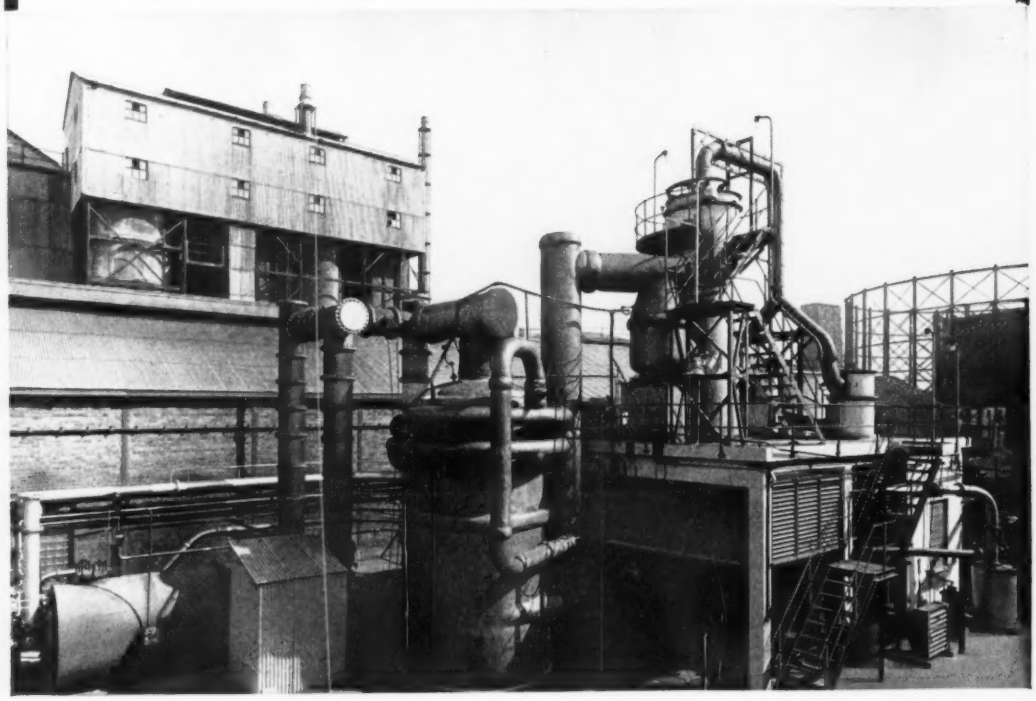

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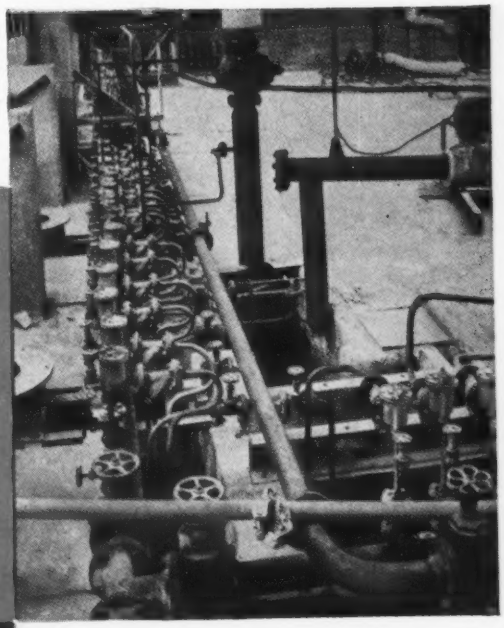

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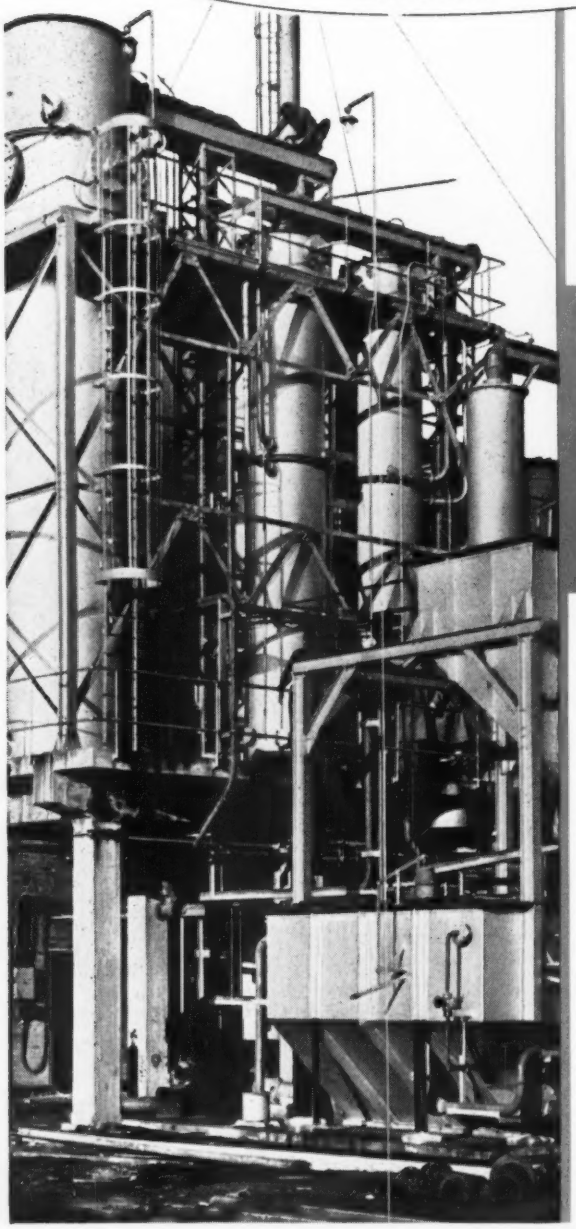

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FOREWORD

IN RESPONSE TO DEMAND, both from home and overseas, we are publishing towards the end of this year, a special issue of our magazine *Sulphur* which will be solely devoted to recent technical developments in sulphur production and use. We have been fortunate in receiving the active co-operation of many leading Companies concerned in these developments and are thus able to present authoritative accounts which should prove to be of special interest to all sectors of the world sulphur industry. This special issue will be made available to subscribers free of charge.

Review

World Prices of sulphur have declined. The abandonment by Texas Gulf Sulphur Company, the world's largest producer, on 17th September of the four year old ex-mine price was followed by the other U.S. Frasch sulphur producers and the resultant new price level—$3 per ton lower—is now $25 per ton f.a.s. for bright sulphur. The reduction, designed primarily to eliminate the differential in U.S. markets between U.S. and Mexican sulphur prices, did not achieve its object as Gulf Sulphur Corporation reacted with a $2 reduction in the price of filtered material making it $23 per ton f.o.b. Coatzacoalcos, while Pan American Sulphur Company, the principal Mexican producer, is re-establishing its competitive position in U.S. and overseas markets without actually posting new prices. The inherent risk of the present situation, following the abandonment of a policy of stability, is a price war the excesses of which could be ruinous to both sides of the sulphur industry. The increasing impact of sulphur recovery on prices and supply, points to greater regional independence and to the need, as required for self-imposed limitation of output by the major Frasch sulphur producers, similar to that practiced by the major pyrites producers in Europe. The attempt to remove the dual price system, which has existed since Mexican sulphur entered world markets, has failed and further attempts as more recovered sulphur capacity comes on stream would seem to be increasingly pointless. The alternative, especially valuable to consumers, would be the assurance of supply coupled with long term stability.

Prices of recovered sulphur in the U.S.A. and in other parts of the world as well as the price of Italian sulphur are being adjusted to conform with the lower price of U.S. and Mexican sulphur, and to take into account the continued low level of sea freights. The combined effect has reduced the delivered cost of brimstone in U.K. and Europe by 13% and elsewhere by 10-18%. This reduction has nullified last June's drop of European pyrite prices and the slight advance in residue values.

Sulphur supplies remain abundant and world stocks of elemental sulphur amount to about five million tons. The immediate effect of the price cut is a reassessment of profitability of some of the small, older domes the reserves of which, if their operations are now abandoned as no longer profitable, may be expected to be lost. The major dome projects in hand appear to be unaffected, as are also the many sulphur recovery projects including those in France and Canada. The development of marginal projects will undoubtedly be postponed and to this extent world production capacity will fail to expand. After 1962, large quantities of recovered sulphur—Canada two million tons, France 1¼ million tons, oil refineries half million tons—are becoming available and the rising trend of sulphur

recovery and possibly also native sulphur ore refining in Poland promises a broader basis of indigenous supplies. For the present, abundance of supplies results in the continuation of intense competition between U.S. and Mexican producers, especially in the U.S.A. and it perpetuates the statistical weakness of the world sulphur market.

Uranium ore processing provides the most recently established major outlet for sulphur. Already some 600,000 tons sulphur in the form of dilute sulphuric acid is consumed annually in leaching the lean uranium ores, in order that from the solution by means of ion exchange or solvent extraction, uranium oxide may be recovered in concentrated form. Current uranium output in the free world is derived principally from uranium ore deposits in Belgian Congo, Canada and U.S.A. and in the gold mining industry of the Union of South Africa, where it is recovered from the gold ore slimes. On a lesser scale, uranium production is being developed in many countries notably Australia, France, Japan, Portugal and Sweden. Recovery in the course of phosphoric acid production is already practised commercially in the U.S.A. and extraction from lignite is under development. By 1959 the anticipated treatment of 30 million tons of uranium ore is expected to entail the use of sulphuric acid equivalent to over one million tons sulphur, of which, however, only a negligible quantity is likely to originate from primary sources such as Frasch sulphur domes. In the four major uranium producing countries, local competitive supplies of by-product sulphuric acid and pyrites and of brimstone recovered from oil refinery and natural gases already monopolise the supply picture and this trend continues. When in the mid 1960's Government subsidies cease and as Canada and South Africa emerge as the most competitive and rapidly expanding producers of uranium oxide, the dominating position of by-product and recovered sulphur as the source of supply of the youngest and potentially one of the largest sulphur using industries, is expected to be further strengthened.

In the **United States** sulphur production in the second quarter declined 5% on account of reduced Frasch sulphur operations. Despite the increase in apparent sulphur sales in this period to 1,561,095 tons, sales to the home market for the first half year were 8½% lower than in 1956, but exports totalling 747,464 tons held at about the same level. Imports of Mexican Frasch sulphur continued to rise in the first half year reaching about one-quarter million tons. Sulphuric acid production during the second quarter was boosted to 4.1 million tons (100% H_2SO_4) but non-acid use of sulphur declined mainly on account of lower rayon and pulp activities. Stocks of Frasch and recovered sulphur continued to rise and at the end of June amounted to 4.23 million tons.

Production of Frasch **Sulphur in Mexico** continues to expand as the result of additional wells and pumping facilities having been put into operation in August and September. These works by Pan-American Sulphur Company and Gulf Sulphur Corporation, coupled with new level of production of about 8,500 tons per month by Texas Gulf Sulphur Corporation at Nopalapa brought daily output to about 3,300 tons rising to 4,000 tons. Pan-American Sulphur Company having shipped the millionth ton is strengthening its position in all markets notably the U.S.A. where the successful establishment of the Tampa, Florida, stockpile last spring is to be repeated further up on the Atlantic East Coast. Gulf Sulphur Corporation is vigorously seeking to expand sales.

In the **United Kingdom** consumption of sulphur in all forms in the second quarter totalled 238,000 tons reflecting the acceleration of industrial activity. Indigenous supplies accounted for 40% of this tonnage while 41% was in the form of imported brimstone, 18% imported pyrites and about 1% imported filter cake. Sulphuric acid production of 586,758 tons (100% H_2SO_4) was 4½% higher than during the corresponding period of 1956 and resulted from the employment of 84% of installed capacity. Sulphuric acid consumption of 582,565 tons was sustained by greater needs of the pigments, man-made fibres and detergent industries which made up for the decline in the use for fertiliser manufacture. Imports of brimstone were reduced to 76,759 tons on account of ex-Government stock being taken

into consumption. Pyrites imports, however, rose to 100,873 tons despite the contrary trend of consumption. The high freight costs increased the import value of sulphur and pyrites to the highest level on record and this factor has been made largely responsible for the widespread rise of 10/- per ton in the price of sulphuric acid last August.

The Sulphur Industry of Italy which by dint of Ente Zolfi Italiani's forceful sales policy and use of State subsidy succeeded in the past year in raising exports to 173,000 tons is now faced with a critical situation on the home market owing to the very high prices charged to domestic users; as the result of the reduction of U.S. and Mexican Frasch sulphur prices coupled with the lower trans-atlantic freights, it faces difficulties in her export markets as well. This threat to the survival of the industry requires a speedy reappraisal of its future function in the light of the domestic needs and the advent of the Common Market. The rising use of sulphur ore in sulphuric acid manufacture is already easing the burden of the efficient pyrites industry and that of the Italian trade balance which has to support a relatively high level of pyrites imports. Subsidies paid only to competitive potential of the Italian sulphur industry might prevent its tradition and great resources from being wasted.

The development of a **Sulphuric Acid Industry in the Philippines** is taking place in conjunction with the expansion of the copper industry. The current output of about 44,000 tons (100% H_2SO_4) is now derived principally from by-product pyrites concentrates. Each of three copper ore mining and treatment projects will give rise to by-product pyrite output and each intend to use this in sulphuric acid and fertiliser manufacture in plants integrated with mining enterprises. Atlas Consolidated Mining and Development Corporation is due to start operations forthwith while the Marinduque Iron Mines Agents Incorporated have two projects under consideration. The abundant supplies of by-product pyrites may be expected to meet domestic needs for acid/fertiliser manufacture and leave a substantial surplus for export under favourable shipping conditions, to Japan and to Europe.

Elemental Sulphur Production in Japan in 1956 reached the record total of 247,582 metric tons and had to be supplemented by the import of 23,000 tons U.S. Frasch sulphur to meet demand. The largest consuming industries, man-made fibres and pulp, accounted for over 86% of the total consumption of 255,200 tons. Since April of this year the curtailment of activities in staple fibre and rayon has reduced anticipated demand and the sulphur producers are now faced with the impending start of competition at home from sulphur recovery at oil refineries and an abundance of cheap sulphur on world markets.

URANIUM and SULPHUR

The impact of a growing industry on future sulphur use.

THE rapid growth of the uranium mining industry, although stimulated in the first place by military needs, may be attributed to the progressive developments of the peaceful uses of atomic energy. In particular the projections of future power requirements which in some industrially advanced economies such as the United Kingdom and many Continental Countries as well as in undeveloped countries might not be fully met by conventional fuels have provided tangible targets for uranium metal production and thereby attracted experienced mining enterprises all over the world into this new sector of the industry. With expansion most of the earlier security restrictions have been rescinded and information is now readily available especially concerning the occurrence of ore deposits, the exploitation and the treatment of ores and so permitting an appreciation of the present and foreseeable impact by this new industry on sulphur usage.

To the sulphur industry the use of substantial quantities of sulphuric acid in the treatment of the uranium bearing ores has been of particular significance as it represents the only major new use in recent years. It is estimated that by the end of last year some 600,000 tons sulphur was consumed in the form of dilute sulphuric acid equivalent to about $1\frac{3}{4}$ million tons (100% H_2SO_4). The projected growth of the uranium industry, which may be expected for some time to come to be based on ores requiring sulphuric acid for their treatment, promises to account for a significant part of the anticipated expansion of world sulphur usage. Contrary to appearances this is not likely to provide an outlet for Frasch sulphur.

Ores

Uranium ores are, with rare exceptions, low grade containing generally between 0.1%-0.5% uranium in the form of oxides and are predominantly tetravalent (black ores) or hexavalent (yellow or green ores). The first step in the production of the hard but malleable uranium metal is the concentration of the uranium oxides present and it is in this essential beneficiation process that—in the case of the bulk of current operations—sulphur plays its part. The extraction of the relatively small quantities of uranium oxide from the large volume of gangue is achieved by leaching. Process economics determine whether acid or alkaline leaching is employed; the majority of ore deposits under current development have a low lime content with the result that acid digestion using sulphuric acid finds the widest application.

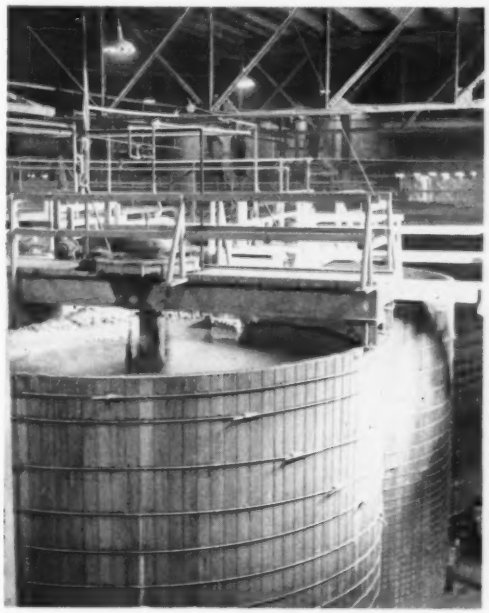
Illustrated above: 'Acid Leaching and Ion Exchange—The Key to Uranium Processing.

The principal uranium ore—pitchblende or uraninite—often occurs in combination with other metals. The outstanding example of commercial importance is the presence of a mixture of hydrocarbons and uraninite in many gold reefs of the Union of South Africa as the result of which, after extraction of gold, the slimes represent the raw material for uranium recovery. The simultaneous presence of pyrites in low concentration offer the unique opportunity of concurrently recovering the entire sulphur requirement of the acid leaching stage. Other important sources of uranium oxide are ores in which uranium is closely associated with metals or minerals. Carnotite (vanadate of uranium) which is exploited in the United States of America and extensively in the U.S.S.R. is of particular significance in view of vanadium. Arising of by-product Torbernite (uranite of copper) and autunite (hydrous phosphate of calcium and uranium) are also potential sources of supply, the latter as by-product of phosphate rock acidulation.

Treatment

Leaching plants employ digesters with air or mechanical agitation into which ground ore, 30 mesh or finer, is dissolved with cold or warm dilute acid. To avoid uranium losses enough acid must be added to pulp liquor to attain a final pH. as high as 1.5. The bulk of the uranium goes into solution in the first hour, but digestion of 16-24 hours is commonplace to ensure maximum recovery. An oxidising agent usually manganese oxide is present to convert the uranium oxide to its more soluble hexavalent form. Single step rather than counter current leaching is preferred for economy reasons. Conventional filtration and clarification, the latter generally aided by a flocculating agent, yield a leach liquor containing per litre about $\frac{1}{2}$-$1\frac{1}{2}$ grams uranium, 20-30 grams SO_4 and 1-5 grams iron and other metal sulphates. Separation is effected by means of column or slurry iron exchange resins or solvent extraction. Neutralisation by ammonia or magnesium oxide yields a diuranate; in the case of ammonia being used, it is a yellow slurry which after calcination is ready for the final conversion process to uranium metal.

The sulphuric acid needs vary widely in accordance with the characteristics of ore. At several Canadian plants for example 50lbs. (100% H_2SO_4) suffice to leach one ton of rock, whilst at some plants in the United States 500lbs. acid per ton rock has to be used. Although an average factor is inherently misleading it is thought that for a broad assessment, a rock/acid ratio 10 : 1 might be indicative of the trend in sulphur demand. In South Africa the requirement appears to be uniform at about 80lbs. acid per ton of gold ore slimes.



Gunnar Mines Ltd. Uranium Oxide leaching section showing some of sixteen Dorr Agitators.

Ore Deposits and Extraction Plants

Whereas the deposits of high grade pitchblende, which prior to the advances in applied nuclear fission were sought as raw material for radium production, were few and far between the occurrence of uranium bearing ores is fairly widespread and almost every country can claim to have deposits, although very often the economics of their exploitation are doubtful. In the Western World the major producers are Belgian Congo, Canada, Union of South Africa, and United States of America, whilst Australia, France, Portugal and Sweden operate or plan to operate on a smaller though still significant scale. About the Soviet Union and the satellite countries little is known beyond the main areas of ore production.

In the following review, salient details of producers and their facilities are summarised.

BELGIAN CONGO

One of the older and until recently the most important source of uranium is the Shinkolobwe mine of the Union Minière du Haut Katanga. Before the war it yielded pitchblende of exceptional quality and grade, and it is believed that current output still has a relatively high uranium content. The sulphuric acid requirements are obtained from the company's by-product acid plant, which makes use of sulphur, contained as SO_2, in the exit gases of the zinc smelter. This plant, which in 1956 produced 117,000 tons (100% H_2SO_4), and which supplies the acid needs of the company's extensive metallurgical activities, is being further enlarged.

CANADA

Whereas in the early stages of the industry's development, which was conditioned mainly by military requirements, uranium ore mining was almost entirely in the hands of the Government controlled Eldorado Mining & Refining Company Ltd., expansion since 1952 of this sector of the industry was undertaken wholly by private enterprise, achieving remarkable results in the past two years. The discovery and development of ore deposits have been such that Canada is now estimated to have the greatest reserves and the largest potential output of uranium oxide in the free world. In these developments, the Rio Tinto Company Ltd., of London, has played a prominent part, and the activities of its Canadian associates are perhaps the key factor in Canada's expected lead in world uranium production. Ore reserves in 1956 were estimated at 225 million tons, containing 237,000 tons uranium. Since then, new developments have substantially added to these figures. Ore production originates from three main areas, situated along the southern edge of the Precambrian shield. These in order of seniority of operations are Beaverlodge (Saskatchewan), Blind River (W. Ontario) and Bancroft (S.E. Ontario).

Beaverlodge Area

Eldorado Mining & Refining Company Limited

The Company's ore mining and treatment operations are carried on at Port Radium (Great Bear Lake), Northwest Territories, and at Beaverlodge and the contiguous township of Uranium City (Saskatchewan). Operations at Port Radium are on a relatively small scale, although it is the oldest installation in Canada having yielded important supplies of radium from pitchblende. A 300 tons per day gravity mill works in conjunction with an acid leaching unit which draws its supplies from an integrated Chemico brimstone-burning sulphuric acid plant of standard design. It has a capacity of 25 tons (100% H_2SO_4) contact acid per 24-hour day, and it receives its sulphur supply in the form of recovered brimstone, originating from the natural gas-cleaning operations in Alberta.

At Beaverlodge early this spring, plant capacity of the Ace-Fay mill was trebled from 750 to 2,000 tons per day ore. About 150 tons capacity is, as hitherto, allocated to the treatment of ores produced from neighbouring privately-owned mines, including Rix-Athabasca Uranium, Consolidated Nicholson Mines, Nesbitt-Labine Uranium Mines and National Explorations Companies. The nature of the ores favours almost exclusively the use of an alkaline leach, although a small proportion of the feed is amenable to acid leaching. This recently-installed section of the plant is supplied by bought sulphuric acid at a daily rate of 2½ tons.

Rayrock Mines Limited

This small operator situated at Marian River in Northwest Territories started operating in June, 1957. Supplies of newly-mined ore to the 150-tons-per-day concentration mill are being supplemented by a stockpile, whilst mine production is being raised.

Gunnar Mines Limited

Situated on the Crackingstone Peninsula on the shore of Lake Athabasca, the company exploits a major uranium ore deposit with reserves unrevealed, but valued in excess of $130 million. Rapid development of the underground mines and the completion of the concentration mill enabled the company to start operations in August, 1955, and by December, 1956, a 32% expansion had raised the daily ore capacity to 1,650 tons. The needs of the acid leaching units were originally met by a Leonard/Monsanto brimstone sulphuric acid plant with a capacity of 100 tons (100% H_2SO_4) contact acid per day, which

was supplemented by a similar plant of 65 tons acid capacity. The brimstone requirements of 28,000-33,000 tons per annum are being met in the form of recovered sulphur originating from the natural gas-cleaning and recovery plants of Royalite and Shell Oil Companies in

Gunnar Mines Ltd. View of uranium mill. Open cast section of uranium mine in background.

Alberta. In the first ten months of operation, costs were 27% below estimates. For the first half-year of 1957 the Company made a net profit of $4.3 million, based on the treatment of 278,087 tons ore estimated to have contained 0.24% U_3O_8 and production of uranium oxide valued at $8.9 million.

Lorado Uranium Mines

The latest comer to this uranium field, the company started operating a custom mill in June, 1957, which in addition to the company's own output of 100 tons per day ore is intended to treat several of the expanding lesser ore productions in the district. They include Cayzor-Athabasca, St. Michael Uranium, Lake Cinch Mines, National Explorations and Black Bay Uranium Companies. With its acid-leaching facilities, the new mill is complementary to the Government plant at Beaverlodge, and its capacity of 750 tons per day is being filled gradually. The grade of ore treated varies between 0.20% U_3O_8 of the company's own ores to O.33% U_3O_8 of Cayzor-Athabasca's output. The sulphuric acid plant is believed to have a daily capacity of 80-100 tons (100% H_2SO_4) contact acid, and is reported to be based on by-product pyrites resulting from local ore treatment.

Blind River Area

Believed to be the greatest uranium field in the world, situated near the town of Blind River, on the north shore of Lake Huron, its development aroused interest mainly as the result of the impressive planning and co-ordination between the Rio Tinto Company, of London, and the Canadian financial and mining interests of Mr. J. H. Hirshhorn. The entire area indicates reserves—not including large near surface quantities containing only 0.07-0.08% U_3O_8—of 150-200 million tons of ore containing about 0.13% uranium oxide and also thorium. The Rio Tinto Mining Company of Canada Limited, has now under its control—partly through holdings in Preston East Dome following the recent share exchange plan – three operating companies *Pronto Uranium Mines, Algom Uranium Mines* and *Northspan Uranium Mines Limited*. Contracts for the delivery of uranium oxide with the Canadian Government are reported to exceed $600 million, the largest total value of any similar Government contract including the largest single contract for $275 million, which was awarded to Northspan Uranium Mines Ltd. Pronto Uranium, having started operations in 1955, last year raised the capacity of their concentration mill by 25% to 1,500 tons. Algom Uranium Company's mines at Quirke Lake, which started operation in September, 1956, and Lake Nordic in January, 1957, rapidly raised the milling rate of the respective plants to their capacity of 3,000 tons per day ore each. Reserves of these two mines are reported as 31.2 million tons ore averaging 0.121% uranium oxide. The three mines of Northspan Uranium Mines Limited are due to enter production this year. The Companies do not manufacture their own sulphuric acid and requirements—thought to be 80-120lbs. per ton of rock—are met by purchase from the plants of Noranda Mines Limited and Canadian Industries Limited. Noranda Mines Limited built a 500-tons-per-day (100% H_2SO_4) plant at Cutler, using the Noranda process which, based on the use of by-product pyrites concentrates, yields two-thirds of the sulphur content as SO_2 for acid manufacture and one-third as elemental sulphur and the iron content in the form of high-grade sinter. This plant started operating on 1st July, 1956, initially using Frasch sulphur, and

to meet the demand a duplicate plant came on stream on 1st July, 1957. Canadian Industries Limited supply acid from their installation at Coppercliff, about 100 miles distant, where the company uses SO_2 in the flue gases of the nickel smelter of International Nickel Company for the manufacture of by-product sulphuric acid.

During the planning stage of the Pronto ore treatment operation, the overall operating costs were estimated at $11 per ton. In the light of subsequent experience in metallurgy, and in particular mining practices at the other larger mines, an improvement of this figure is probable. During the six months ended 31st August gross revenue of Algom Uranium Mines Limited, which started operations in October, 1956, but were held up for some time with initial difficulties in the leaching plant, amounted to $23.6 million. Net profit before depreciation was $9.8 million, nearly half as much again as estimated in the original prospectus. Operating costs on the 1,097,470 tons milled are calculated at $10.47 excluding interest, mining taxes and administration which account for $2.09 per ton.

Consolidated Denison Mines Ltd., the other major enterprise in the area and the world's largest single uranium mine, is now in operation with an initial treatment rate of 4,000 tons per day ore. Within the next two months the daily rate of operation is expected to be raised to 6,000 tons. Proved ore reserves, not including the two additional mineralised zones above and below, total 136 million tons containing 0.139% U_3O_8, in an orebody which strikes 2¾ miles in length. A contract, valued at $202 million, has been secured from the Government refining plant for concentrate deliveries up to March, 1963.

Algom Uranium Mines. General view of Quirke Lake mill.

Two smaller mills owned by the *Stanleigh and Stanrock Uranium Mining Companies* are to start operation early next year. Their sulphuric acid needs will be met by Canadian Industries Limited.

Bancroft Area

The discovery in 1954 of uranium ores deposits in the Bancroft district situated 150 miles north east of Toronto has given rise to a number of development projects which are now being realised.

Bicroft Uranium Ltd. started mining and milling operations in the Autumn of last year treating during the start-up period lower grade ores sufficient to cover costs. The plant capacity of 1,000 tons per day is now fully used and shows increasing profit. Uranium recovery is in excess of 90% based on ores containing about 0.137% uranium oxide compared with about 0.121% earlier. Operating profits have increased progressively to an annual rate $2 million. The company obtains its sulphuric acid requirements of 80 tons per day from Canadian Industries Ltd. in the form of by-product acid recovered from nickel smelter gases at Copper-cliff.

Faraday Uranium Mines Ltd. officially opened their plant on 30th May. Previously the 1,000 tons per day mill was fed from a two million ton uranium ore stockpile. Mine supplies of high grade ore average 0.137% U_3O_8. Mill capacity is to be raised to 1,500 tons ore and then daily sulphuric acid needs will increase correspondingly from 40 to 60 tons. They are purchased from Nichols Chemical Company's pyrites acid plant at Sulphide, Ontario. In May and June mine profits are reported as $277,000 and $300,000 respectively. Faraday's mill is also expected to process ore from Greyhawk mine supplied under a treatment contract.

Canadian Dyno Mines Ltd. who own substantial ore reserves which are reported to offer good prospects, are installing a concentration mill with a daily ore capacity of 1,100 tons, plus a 10% safety factor and due to start operating early in 1958. Consumption of sulphuric acid for leaching is expected to be 40-50 lbs. of 66° Bé acid per ton ore, the lowest rock/acid ratio reported from Canada. Supplies will be purchased and the company is seeking competitive tenders from the Nichols Chemicals Co., Canadian Industries Ltd., North American Cyanamid Company and Shawinigan Chemicals Ltd. preferably for a five year period in the course of which up to 55,000 tons sulphuric acid may be consumed.

To sum up the Canadian picture: The current operations derive their support principally from the purchases by the Government controlled uranium refinery at Port Hope of Eldorado Mining and Refining Company Ltd. At present for each 1lb. of uranium content in concentrates of 10% U_3O_8 and more, there is a guaranteed price of $6 plus $1.25 premium for mine developments in the first three years. The actual contract prices concluded with the 17 operating companies under five year supply contracts, however, vary but in all instances cover production costs, enable the company to write off all plant and production expenses and give a reasonable return on capital. The following premium price contracts are in force:—

Region / *Company*	*Gross Value of Contract* $ *mill.*
Blind River (West Ontario)	
Algom	207
Can-Met	79
Cons. Denison	202
Milliken Lake	94
Northspan	275
Pronto	55
Stanleigh	90
Stanrock	95
Beaverlodge (Saskatchewan)	
Gunnar	77
Lorado	64
Bancroft (Ontario, 120 miles N.E. of Toronto)	
Bicroft	36
Cavendish	24
Dyno	30
Faraday	30
Greyhawk	20
Marian River (N.W. Territories)	
Rayrock	16
Kamloops (Cent. Br. Columbia)	
Rexspar	21

The combined milling capacity of these plants and the Government plants is at present approximately 22,500 tons ore per day, which entails the annual use of 350,000 tons sulphuric acid. When projects in hand come into operation by 1958 this may be expected to rise at least 15% and possibly as much as 50% if the official forecast of uranium oxide output is realised. By the end of the current support programme in 1962-1963 installed daily ore treatment capacity is expected to total 41,500 tons ore which assuming the maintenance of established rock/acid ratios implies the annual use of three-quarter million tons acid, more than Canada at present uses in the manufacture of fertilisers.

UNITED STATES

In contrast with the earlier days of uranium prospecting and mining by small operators and syndicates, the U.S. industry is now supported principally by the great names of the U.S. mining and chemical processing industries. Apart from the all-imporant factor of experience and resources, this move was accelerated by the discovery of the New Mexico deposits which dwarfed all other

known U.S. deposits and by the extension, under certain conditions, of the Government guaranteed market until 1966, which induced many of the larger companies to commit substantial funds on exploration and development, especially in New Mexico.

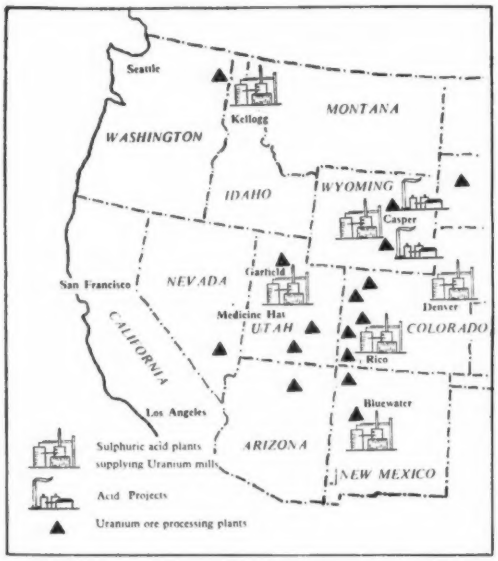


Fig 1.

Ore reserves on 31st December, 1956, were estimated to total 60 million tons containing average 0.25% U_3O_8: They were distributed as follows:—

New Mexico	41 million tons
Utah	7.5 „
Colorado	4.1 „
Arizona	2.6 „
Wyoming	2.3 „
Washington	1.5 „
Others	1.0 „

New Mexico

Intensive exploration by several major U.S. companies is adding to known reserves. Already the Ambrosia Lake area is said to show over 30 million tons ore, averaging 0.25% U_3O_8 over widths of 10 feet and rising in some instances to 0.50% U_3O_8 and widths of 90 feet. The Jackpile mine area 35 miles south-east of Ambrosia Lake, with known reserves of 15 million tons of 0.16% U_3O_8 ore, also indicates greater possibilities. A third area, Haystack Poison Canyon, has known reserves of about one million tons ore.

Existing installations, including those due to start operation by early 1958, are:—

Company	*Location*	*Ore capacity. Tons per day*
Anaconda Mining Company	Bluewater	3,000
Kerr McGee Oil Industries Inc.	Shiprock	500
Homestake New Mexican Partners	Grants	750

Construction contracts are said to be under negotiation for the following:—

Homestake-Sabre-Pinon Partners	Grants	1,500
Phillips Petroleum Company	Grants	750
Kermac Nuclear Fuels Company	Grants	3,300

Kermac Nuclear Fuels is an amalgamation of interests of Kerr McGee Oil Industries, the well-known oil company, Pacific Uranium Mines, a small, hitherto little-known company, and Anderson Development Corporation, a private company. When their new plant comes on stream, probably next year, it should be the largest mill in the United States.

A large proportion of the New Mexican ores have a high lime content, which favours the use of carbonate leaching. This applies to the operation of the Anaconda Company at Bluewater, but to treat the sandstone ores from the Jackpile deposits, acid leaching is employed. Two such units are installed, served by a 75-tons-per-day brimstone contact acid plant.

Kerr McGee Oil Industries Inc., at Shiprock, purchases sulphuric acid produced from by-product pyrites by Rico Argentine Mining Company. The Phillips Petroleum Company's plant is to be based on carbonate leaching, and the other installation at Grants are expected to be similar.

Utah

Mills at present in operation are:

	Location	*Ore capacity Tons per day*
Atomic Energy Commission	Monticello	600
Uranium Reduction Company	Moab	1,500
Vitro Uranium Company	Salt Lake City	550
Texas-Zinc Minerals Co.	Mexican Hat	775

Each of the above mills employ acid leaching, and with the exception of the last-named, are based on the use of purchased sulphuric acid. The Monticello mill obtains acid from the Rico Argentine Mining Company, while the Moab and Salt Lake City mills receive supplies of by-product sulphuric acid from the copper smelter at Garfield. The

Moab plant treating relatively high lime ores uses 330 tons per day of 66° Bé acid, a ratio of approximately 500lbs. per ton of rock.

The mill at Mexican Hat, which is owned jointly by the Texas Company and New Jersey Zinc Company, is to have an integrated brimstone acid plant with a daily capacity of 70 tons (100% H_2SO_4) the needs of which are to be met by recovered brimstone supplies from local sources.

Colorado

Mills at present in operation or due to early in 1958 are:—

	Location	*Ore capacity Tons Per day*
Climax Uranium Co.	Grand Junction	350
Union Carbide Nuclear Co.	Uravan	850
Union Carbide Nuclear Co.	Rifle	280*
Vanadium Corp. of America	Durango	430
Vanadium Corp. of America	Naturita	350
Atomic Fuels Extraction Co.	Bedrock	200
Gunnison Mining Co.	Gunnison	200
Trace Elements Co.	Maybell	300
Coffer Corporation	Cannon	100

Based on acid leaching, all individual mills at present appear to be purchasing acid: suppliers are the Rico Argentine Mining Company and the Garfield Chemical and Manufacturing Corporation. The possibility of Union Carbide building an integrated sulphuric acid plant has been mooted, and may be realised if bought acid became dearer.

Arizona

The concentration mill of Rare Metals Inc. at Tuba City, Arizona's sole producer, has a daily ore capacity of 250 tons. The acid leaching unit consumes 675 tons per month of 98% sulphuric acid which is purchased from Garfield Chemical and Manufacturing Corp., which supplies by-product acid recovered from copper smelter gases.

Wyoming

Both mills are new projects starting operations this year.

	Location	*Ore capacity Tons per day*
Western Union Nuclear Company	Split Rock	400
Lucky Mc Uranium Corp.	Freemont County	750

In the Gas Hills-Crooks Gap field in central Wyoming substantial additional reserves have been discovered, and two major projects are being considered. Lucky Mc Uranium Corp. with Phelps Dodge Corporation and Globe Mining Company with Union Carbide Nuclear Company are each envisaging the erection of a 1,000-tons-per-day ore concentration mill. Other mill projects are envisaged by Freemont Minerals Inc., and Giant Resources, Inc.

Sulphuric acid supplies at present originate mainly from the Denver plant of Allied Chemical & Dye Corporation, which is based on by-product pyrites mostly supplied by Climax Molybdenum Co. These increased needs have contributed to three acid projects being initiated. With a combined acid capacity of 575 tons per day (100% H_2SO_4) the plants, all of which are sited at Casper, are owned by Platte Chemical Co., Oil Inc. and Davison Chemical Co. Their operations will be principally based on recovered sulphur in acid sludges, H_2S and liquid brimstone recovered from gas-cleaning operations.

Washington State

Existing ore reserves, which are being augmented by developments in the Spokane area, are being exploited by the Dawn Mining Company. The sulphuric acid needs of the 400-tons-per-day ore concentration mill at Ford are supplied by the Bunker Hill Company in the form of by-product sulphuric acid recovered from zinc smelter gases from their plant at Kellogg, Idaho.

Others

Amongst developments in other parts of the U.S.A., the 300-tons-per-day concentrates mill of Mines Development Inc., which came on stream in July, 1956, at Edgemont, S. Dakota, is of interest, as it was the first mill built outside Colorado. The company now envisages at least a 50% expansion. Acid leach requirements of 600 tons per month of 60° Bé acid are met by supplies of pyrites acid brought by rail from Allied Chemical & Dye Corporation's plant at Denver.

Summary

In 1956, output of uranium concentrate totalled 6,000 tons, and installed milling capacity by the end of the year was 8,960 tons ore per day. During 1956 nine new contracts involving construction of eight mills and one mill expansion were approved by the Atomic Energy Commission whereby the number of mills in operation by early next year should rise to twenty. In the first half of this year 1,620,000 tons, 3% less than in the preceding 6 months, was milled, and it is estimated that 155,000-165,000 tons acid (100% H_2SO_4) was

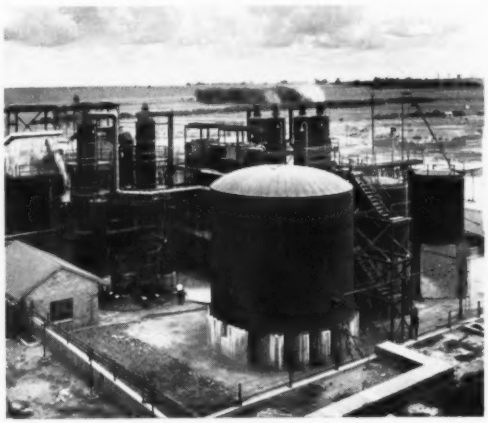
* To be replaced by a 1,000 tons per day mill which is under construction.

consumed in this period. It is anticipated that these developments totalling 4,000 tons new milling capacity and an even greater tonnage projected, but not yet approved, will raise treatment capacity to 18,305 tons uranium ore per day. As important new developments in New Mexico are expected to employ carbonate leaching, sulphuric acid needs may not expand as much, and the use of about one-half million tons sulphuric acid annually after 1958 is probable.

UNION OF SOUTH AFRICA

The occurrence of small quantities of uranium oxide in the principal gold bearing reefs, in particular the Kimberley Reef in the East Rand, the Bird Reef in the West Rand, the Carbon leader in the Far West Rand, the Vaal Reef in the Klerksdorp area and the Basal Reef in the Orange Free State gold field has not only opened a major source of uranium supply but has profoundly influenced the economics of the gold mining industry. The combined value of gold and uranium permit in many instances the exploitations of deposits which for one or other minerals could not be profitably worked. Indeed it appears that over one-third of the working profits are derived from the recovery of uranium oxide, pyrites and the manufacture of sulphuric acid. The main impetus to the uranium developments in the Union were provided by General Smuts in the closing days of the war and this preparatory work resulted in the initiation of the production programme in 1950/51.

Compared with the quality of Canadian and United States ores the uranium content of the gold ore is very small ranging from 0.06% U_3O_8 at Randfontein to 0.011% at Loraine and averaging about 0.027%. The ability and experience of the gold mining industry to handle very large volumes of ore are, however, compensatory factors of which full advantage was taken in the course of the uranium development. As indicated above, the presence of small quantities of pyrite in the gold slime offered a low cost indigenous source of sulphur and the extensive new sulphuric acid installations are all based on these recovered supplies.



West Rand Consolidated. General view of the two 25 tons per day sulphuric acid units.

Since the installation of the first mill and acid plant by West Rand Consolidated in 1952, another sixteen uranium concentration mills* as well as a further seven sulphuric acid plants have started to operate.

Acid leaching is employed in each of the gold slime processing plants. Common features to all sulphuric acid plants are the use of Dorr FluoSolids pyrites roasters and of Chemico contact sulphuric acid convertors, a combination which when introduced in 1952 was unique. At present daily acid output 1,650 tons (100% H_2SO_4) is derived from the roasting of 1,450 tons pyrite concentrates containing 35-45% sulphur averaging 38% in 1956.

Pyrite flotation plants constructed to supply the needs of the acid units in South Africa are as under :—

Mines	*Estd. Production, Tons of FeS_2/Day*	*Date Started*
West Rand Consd. Mines Ltd.	180	October 1952
Daggafontein Mines, Ltd.	180	April 1953
Western Reef Explor. and Devel. Co. Ltd.	155	September 1953
Government Gold Mining Areas	325	May 1954
Vogelstruisbult G.M. Areas, Ltd.	90	December 1954
Virginia O.F.S.G.M. Co. Ltd.	150	July 1955
Harmony G.M. Co. Ltd.	70	January 1957
Buffelsfontein G.M. Co. Ltd.	75	July 1957
Total	1,225	

* For further details see Appendix A.

Details of individual sulphuric acid plants are as follows:—

Company	Capacity Tons H_2SO_4	Date of operation
West Rand Consolidated Mines Ltd.	50	Sept. 1952
Daggafontein Mines Ltd.	200	Mch. 1953
Randfontein Estates G.M. Co. (W) Ltd.	250	Feb. 1954
Western Reefs Exp. Dev. Co., Ltd.	200	Sept. 1953
Virginia O.F.S., G.M. Co. Ltd.	350	Jan. 1955
Stilfontein G.M. Co. Ltd.	225	Oct. 1955
Blyvooruitzicht G.M. Co. Ltd.	150	Oct. 1956
Buffelsfontein G.M. Co. Ltd.	100	July 1957

With the start of operations of the Buffelsfontein Gold Mining Company's mill early in October resulting in an installed mill capacity of 50,000 tons gold slimes per day, the target set by the Combined Development Agency under its present planned programme has been achieved. The corresponding level of pyrite recovery of about one-half million tons per annum containing 200,000 tons sulphur, permits the manufacture of 550,000-600,000 tons sulphuric acid for uranium ore processing.

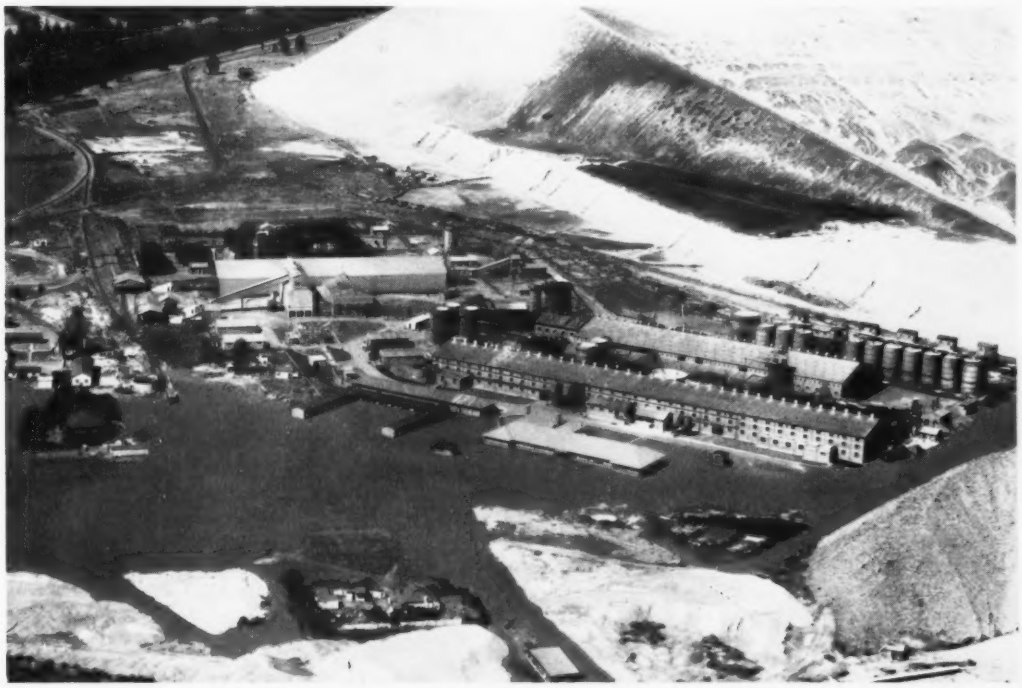
At the beginning of 1957 there were twenty-nine authorised uranium producing mines, the number of which continues to increase. The following table shows details released by Atomic Energy Board and covering the fourth quarter 1956 operations.

	Ore treated	U_3O_8 Content in lb.	Net Profit £	Reserves in 000 Tons*
Ellaton	88,250	26,461	36,475	576
Hartebeestfontein	188,181	130,049	305,783	1,682
New Klerksdorp	57,156	17,625	24,748	250
Stilfontein ..	278,200	76,117	119,475	4,286
Vaal Reefs ..	160,694	90,360	233,600	1,480
Western Reefs ..	622,116	161,158	252,818	4,562
Blyvooruitzicht ..	468,001	135,795	188,721	6,865
Doornfontein ..	70,200	15,803	15,200	1,246
West Driefontein	85,800	22,124	16,300	1,438
East Champ d'Or	34,500	26,106	20,278	161
Luipaardsvlei ..	136,000	176,891	121,000	644
Randfontein ..	393,000	375,903	259,427	1,710
West Rand Cons.	226,000	304,462	546,998	3,384
Daggafontein ..	368,442	126,639	217,224	4,588
Vogelstruisbult ..	130,800	60,770	79,000	1,098
Freddies Consol ..	——	47,187	65,000	1,193
Loraine Gold Mines	——	22,061	22,589	1,102
President Brand ..	——	51,511	66,741	2,501
President Steyn ..	——	72,405	104,462	3,102
Harmony Gold Mines	251,989	111,350	160,300	1,846
Merriespruit ..	64,700	4,904	4,235	843
Virginia Gold Mines	390,683	181,997	332,351	1,588

* As at end of 1956

AUSTRALIA

There are at present two uranium ore concentration mills in operation, both employing acid leaching. The Government concentration mill at Rum Jungle, Northern Territory, treats in addition to local ores, private productions from the nearby mines of Uranium Mines N.L. and Northern Uranium Development N.L. Sulphuric acid



Randfontein Estates, the largest U_3O_8 producer in South Africa. General view of gold and uranium mills. Sulphuric acid plant left centre.

supplies are provided from an integrated brimstone contact acid plant which is based on imported sulphur. In South Australia, the output from Radium Hill is treated at a mill which receives its acid needs from the Port Pirie plant of Sulphuric Acid Ltd.; this is based on local pyrites concentrates. The new project of Mary Kathleen Uranium Mines, a Rio Tinto subsidiary in Northern Queensland, includes provision for an integrated brimstone acid plant of 110 tons per day capacity based on imported supplies.

Other Countries

Several countries contemplate the exploitation of indigenous uranium ore resources. Amongst them France has made important strides and has established an ore concentration plant at Gueugnon (Sâone-et-Loire) with an annual treatment capacity of 150,000 tons ore. Two further plants at Ecarpiere (Loire Inf.) and at Bessines (Haute Vienne) are under construction and are designed to treat 200,000 tons and 300,000 tons ore annually but there are no indications of special provision for the manufacture of sulphuric acid and established acid makers may be expected to supply needs as required.

The development in Sweden of uranium ore extraction from oil shale is reported to be making good progress.

In Southern Rhodesia a small uranium mill is operating adjacent to the Nkana mine of the Rhokana Corporation.

Other potential major sources of supply are Portugal, Brazil, Japan and India. The Japanese developments in particular command attention as a new concentration and refining process by "evaporation" may be employed. This method, said to be cheap and particularly suitable for the treatment of low grade ores, entails the heating of pulverised ores in a furnace at 700-800° C in the presence of a gas mixture of chlorine and carbon monoxide gas and it would appear to obviate the use of sulphuric acid.

By-Product Uranium

The recovery of uranium oxide present in phosphate rock has advanced significantly both in theory and in practice. Florida pebble and North African phosphate rock and several lesser productions contain up to 200 parts per million U_3O_8 which is comparable with the content of the poorer South African gold ore and slimes. Acidulation of rock offers recovery possibilities which has been given effect in the manufacture of phosphoric acid. International Minerals & Chemical Corp. at Bartow, Florida, and Minerals & Chemical Corp. of America at Philadelphia, Pa. and at Lakeland, Florida are in production, while Virginia-Carolina at Nichols, Florida, United States Phosphoric Products (a division of the Tennessee Corporation), Blockson Chemicals Inc. are also active in this field. In the United Kingdom, Imperial Chemical Industries Ltd. have developed a process at Billingham which offers 80% overall uranium recovery. As the manufacture of this form of phosphate fertiliser is expanding—in the United States of America alone, present capacity is 2.2 million tons triple superphosphate—this source can be expected to make a useful contribution to orthodox uranium supplies. The testing of a process for the extraction of uranium oxide from lignite is in progress in the United States of America.

Conclusion

The short term prospects of expansion of the world uranium industry as outlined above indicates that by 1959 uranium oxide output in the West would rise to about 30,000 tons representing the treatment of 30 million tons of ore from the present-day level of operations of about 20 million tons ore per annum. It is evident that, with isolated exceptions, the uranium industry everywhere has been able to use recovered sulphur supply in one or other form to meet its sulphuric acid needs and despite the resultant greater overall world sulphur consumption, no positive impact on primary sulphur supplies, notably, on Frasch sulphur has occurred. Nor is any significant change indicated in the foreseeable future and in 1959 it is estimated that in the manufacture of uranium oxide about one million tons sulphur will be used, which will be derived almost exclusively from other than primary sources.

The further expansion of uranium production, which according to Dr. W. F. Libby of the U.S. Atomic Energy Commission could rise to 100,000 tons U_3O_8 in the decade following 1962, may be expected to take place under competitive conditions as the various Governments support of price programmes terminate in the mid-1960's. The likely emergence of Canada and South Africa as the most competitive producers capable of rapid expansion would strengthen the dominating position of by-product and recovered sulphur as the sources of supply for the needs of the youngest major sulphur user.

Price Policy at Crossroads

The New Sulphur Prices

The announcement of the Texas Gulf Sulphur Company on 17th September, 1957, that the Company's domestic* selling price of bright sulphur would, after more than four years stability, be reduced by $3 per ton was received by sulphur producers and users throughout the world with surprise and to some it came as a profound shock. The sudden change in the marketing and price policy of the world's largest sulphur producer raises the question what benefit, if any, the sulphur industry, from Texas Gulf Sulphur Company down to the most humble user, might derive?

The Company's decision to reduce prices has come after a period of endeavour to reverse the declining level of profits and volume of sulphur sales. These adverse features appear to have made a greater impact on Texas Gulf's activities than on the other established Frasch sulphur producers in the United States, even though the underlying causes were common to the industry.

World Production and Consumption

The significant expansion of United States Frasch sulphur capacity which has taken place in the past five years owed its impetus to the apparent shortage of elemental sulphur during the sulphur crisis of 1951. This caused sulphur consumers throughout the world to doubt the ability of the Frasch sulphur industry to remain a stable and long term source of cheap sulphur. The outstanding success of the Four-Dome programme of the Freeport Sulphur Company culminating in the prolific output at Garden Island Bay after 1954 and the subsequent heavy investment in the tideland and off-shore dome projects was an effective reply, particularly as it was accompanied by continuously rising production at the domes of other companies. The price increase of 1st January, 1954, affecting principally overseas markets coincided with the fulfilment of heavy capital investments and the expectation of the development of large scale production in Mexico. At that time this was not unwelcome to the United States industry as its realisation would help to strengthen Frasch sulphur as a long-term assured source of supply.

Marketing policy appeared to be based on a spirit of co-existence in what was thought to be a rapidly expanding market in which the United States industry was confident of maintaining its share at the then obtaining level of prices i.e. $26.50 per ton ex-mine to domestic and Canadian users and $31 f.a.s. to overseas customers. By 1956 the Pan-American Sulphur Company had succeeded in building up its operation at Jaltipan, Mexico, to an annual level of one million tons filtered sulphur and, with the capacity to produce 50% more, pursued an understandably aggressive sales policy in United States and overseas market to establish long term outlets for its production which was now universally accepted as an assured source of supply. A similar development on a smaller scale occurred when Gulf Sulphur Corporation entered production in mid 1956. By the end of 1956 the peak output in the United States coupled with the high level of Mexican sulphur output had outstripped the expansion of consumption and the world sulphur market was profoundly weakened. United States and Mexican Frasch sulphur output had increased 40% since 1950 to 7.25 million tons while deliveries had risen to only 6.68 million tons, an increase of 19%. The main contributory factors which restricted the potential sulphur markets for Frasch sulphur were principally the strong expansion of sulphur recovery in various forms and to a lesser extent the unfulfilled expectation, due to the rise in residues values, of European pyrites use to recede more rapidly. It is significant that taking the United States picture in isolation it is found to be almost in balance as the domestic use of elemental sulphur rose nearly 20% between 1950 and 1956 while Frasch sulphur production rose 22%. By then, however, 10% of the market had been taken by Mexican sulphur imports and the greater availability of recovered brimstone which was reflected in the steep rise of United States Frasch sulphur stocks, notably those of Texas Gulf. This year this trend continued although United States producers retrenched production under pressure of receding sales.

Marketing and Prices

When last February the Freeport Sulphur Company led the way in rescinding the differential of $3 per ton between United States domestic and export prices, this decision was

* Including Canada

not in conflict with United States producers' policy to maintain stability as it levelled the United States price to all markets and Mexican suppliers' prices remained unaffected at their lower level. Several new factors were, however, beginning to exert their influence and there is now little doubt that they are at the root of the latest price cut. Whereas previously some difference between United States and Mexican sulphur, even in off-colour grades was justified on account of quality, the improvement of Mexican sulphur by the introduction of filtering had largely removed this and in consequence a firm impression of the advantages in using cheaper Mexican brimstone was being established. This development was accentuated by the outstanding success, in terms of deliveries and new customers by Pan-American Sulphur Company's decision to build a stockpile at Tampa, Florida. This original concept of anticipating customers requirements and at no penalty providing an "over-the-counter" service gave local sulphur users, who incidentally are the largest phosphate fertiliser manufacturers in the United States, a tangible advantage in terms of lower cost into works. This was followed during the summer by the establishment of another stockpile along the Atlantic seaboard. Lastly the longer term outlook which showed the alarming impact on future United States sulphur sales of the developments of recovered sulphur, especially in Canada and France, which were casting their shadow before them.

This situation had a parallel on this side of the Atlantic in the pyrites industry, but perhaps in keeping with the European leaning towards trade solidarity, the once overwhelmingly strong Spanish producers accepted the inevitable decline of their share of the market for the sake of stability and maintenance of the highest possible price.

Texas Gulf Sulphur Company in abandoning their apparently established policy of price stability would appear to have been moved primarily by the wish to regain some marketing initiative in Florida and the Atlantic seaboard by quoting level prices with Mexican supplies in an endeavour at least to halt the drift of old customers and possibly to secure some new ones. On the following day the Freeport Sulphur Company matched the $3 reduction and extended it to overseas customers. To remain competitive at home and abroad Jefferson Lake Sulphur Company then aligned their price and Texas Gulf Sulphur extended the reduction to export markets. Of the Mexican producers Gulf Sulphur Corporation announced new prices $2 below the new United States prices while Pan-American Sulphur Company maintained its freedom of action to sell competitively.

The new levels of United States and Mexican prices now appear as follows:—

	Bright	*Filtered*	*Off-Colour*	*Reduction*
Texas Gulf Sulphur Company ...	$25	—	$24.50	$3 & $2.50 Off-Colour
Freeport Sulphur Company ...	$25	—	$24	$3
Jefferson Lake Sulphur Company	$25	—	—	$3
Duval Sulphur & Potash Company	$25	—	—	$3
Pan-American Sulphur Company	—	$24*	$21.50*	Not applicable
Gulf Sulphur Corporation ...	—	$23	$22	$1

* Price indications NOT posted prices.

Effect on United States Consumers

The reduction of sulphur prices by $2-$3 per ton is not likely to benefit the majority of sulphuric acid makers in the United States as their sales contracts of sulphuric acid or fertilisers usually embody a raw materials rise-and-fall clause. Many influential sulphur buyers have pointed out that they are more interested in the assurance of future supply than in lower prices which, as they apply to their competitors as well as themselves, give them no competitive advantage.

Effect on Frasch Production

The immediate effect on the ageing United States Frasch sulphur industry is the necessity to re-examine the profitability of several domes and it not unlikely that several lesser domes may be closed and the life of a number of others appreciably shortened. Sulphur so abandoned is unlikely to be recoverable in the future as the re-installation of plant on a partly exhausted deposit is hardly ever justified.

To the young Mexican sulphur industry which enjoys low operating costs the price cut is hurtful in that it delays the establishment of financial reserves and prevents the generous

servicing of capital which shareholders have come to expect from the sulphur industry. Unquestionably in other sectors of the sulphur industry marginal projects or production will be abandoned. This does not necessarily apply to production serving principally domestic markets such as in Japan, Italy, or Chile.

Individual producers shares of existing markets are unlikely to be affected as a result of the price cut because the differentials remain. Thus the competitive relation between the United States producers, amongst whom in recent years the Freeport Sulphur Company appears to have noticeably improved its position, should not alter. Of the Mexican producers, Gulf Sulphur Corporation appears to have moved into a militant position intent on using the price weapon to secure more custom. Pan-American Sulphur Co. who, in co-operation with International Ore & Fertiliser Corporation has established a customer service on an unprecedented scale, may be expected to continue reaping the benefit in terms of rising sales volume. It may be expected that the present successful sales policy will continue until the company's level of production and sales is brought closer in line with plant capacity although it is evident, by the absence of a new price announcement, that, while wishing to remain competitive, the Company is anxious to avoid precipitating a price war.

To Texas Gulf Sulphur Company the lower level of prices would seem to entail a loss of revenue of $6 million and with small prospects of securing the additional one quarter million tons of new custom which would be needed to balance the financial position.

Outlook

Concurrently with these developments, operation started at the natural gas cleaning plant at Peace River, British Columbia, where Jefferson Lake Sulphur Company are preparing to produce 300 tons sulphur daily. This trickle of new Canadian recovered sulphur will, according to well-informed sources, become a steady stream of at least two million tons by 1960. It is already accepted that this will supplant Frasch sulphur in the west and north-west of the United States and Canada, and probably the entire Far East and Australasia. As the competitive radius of these supplies is limited only by freight charges it may be assumed that progressively it will encroach on Frasch sulphur markets in the northern and mid-western States. Sulphur recovery is expanding rapidly throughout the world, notably in Europe where after 1962 the arising of one million tons high purity sulphur at Lacq in France will give it a dominating position. The inherent merit of recovered sulphur supplies is their stability and competitive "delivered" cost. The sales policy of the Mexican Frasch sulphur producers in establishing forward stockpiles in selected markets aims to achieve the same result.

The alternatives that now confront the industry are either rationally to stabilise prices and marketing or to continue the price war, the excesses of which could depress the price to a ruinous level and seriously damage the whole industry. The full damage especially in the United States is not capable of precise assessment as it might involve not only premature cessation of dome exploitation with consequent loss, for ever, of the unexploited sulphur reserves but also the too rapid depletion of the most competitive domes. From the consumers point of view there is the further danger of the price pendulum swinging too far in the opposite direction as soon as insufficient production capacity brings out the weakness of the narrow sulphur market. A precipitate price cut now, followed by the depletion of stocks due to a reduction of output resulting from the cessation of uncompetitive operation could hold the germ of another temporary supply crisis.

The natural corrollorary of price stability would be the emergence of fairly clear cut zones of favourable marketing influence without, however, introducing rigidity or promoting price rings especially as major importers like the United Kingdom would not be prepared to rely solely on one source. The implication of this is a self-imposed control of output on the part of Frasch sulphur producers in relation to available markets which would, incidentally, result in prolonging the life of the domes. No assessment of the sulphur industry's future would be complete without allowing for the conservatism of sulphur users. Far from being manifested by unquestioning adherence to established suppliers or forms of sulphur supply, it is nevertheless a potent factor mitigating against violent fluctuations. Whatever the reasons for the decision leading to the present price cut it is thought the prosperity of the sulphur industry—producers and users alike demands a return to stability.

PRICES AND TRENDS

Prices and Trends

The recent reduction of the level of world prices accompanied by the further decline of sea freights has reduced the delivered cost of brimstone in the United Kingdom and Europe by about 13% and at other destinations between 10-18%. At the new price levels which are discussed in detail above, competition remains intense between United States and Mexican suppliers. Unfiltered Mexican sulphur held in stock is reported to be moving slowly, and commands a discount.

The price policy of the Ente Zolfi Italiani is being severely tested as the combined effect of lower Frasch sulphur prices and low freights has curtailed the number of countries where the level of subsidy allows competitive selling. There has been no indication that Ente Zolfi Italiani had abandoned the notional prices of Lire 23,000-25,000 per metric ton f.o.b. (min. 99% S). It is however significant that United States and Mexican Frasch sulphur could land Mediterranean markets at about Lire 20,000 per ton.

Sales of French recovered sulphur by Soc. des Petroles d' Aquitaine are now based on the new landed prices of United States and Mexican sulphur. Producers of recovered sulphur in Western Europe have made corresponding reductions. Orkla Metal A/S is reported to have reduced the price of their brimstone output, but even so the price in Sweden and Finland appear to be subsequently above world price.

The following table indicates broadly the delivered cost of brimstone of varying origin at principal consumers' destinations. The freight rates shown are either actual charters made at the end of June, or reliable indications.

Pyrites

The price level of European pyrites of £4-£4 15s. remains unchanged. There is no indication that the cut in brimstone price will have any repercussion on pyrites prices, although the price reduction of up to 7/6 per ton pyrites in June and the modest advance in residues return since is now nullified by the $3 reduction of United States Frasch sulphur. The upward trend of residues values is imposing a limit on the advantages of conversion to brimstone usage. The continued decline of sea freights favours pyrites and lower the freights charges make Cuban, Canadian and even Philippine pyrites and concentrates competitive in Europe.

Freights

Throughout the summer months freights continued to decline and the absence of cargoes, especially bulk commodities depressed freights below economic limits. It is estimated that about one quarter million tons of shipping is already laid up. The United Kingdom Chamber of Shipping Voyage Index (1952=100) has declined from 117 in May to 81. Low cost commodities including brimstone, pyrites and phosphates have derived full advantage of the cheap freight rates. There is no indication of a strong upward trend of rates during the winter, unless a combination of all adverse factors that could befall coal and grain in the United Kingdom and the Continent were to occur. Nevertheless owners are reluctant to engage far ahead and while spot rates on the London market continues to decline, charters into 1958 are offered at levels of up to 20/- above spot for transatlantic voyages. Freight

f.o.b. Country of Origin	*U.K.*	*N.W. Europe*	*France (Mediterranean)*	*India*	*Australia*
U.S.A. $24—25	(52s.) £11 1/4—11 5/8	(50s.) £11 1/8—11 1/2	(52s.) £11 1/4—11 5/8	(75s.) £12 1/8—12 1/4	(75s.) £12 1/8—12 1/4
Mexico $22—24	(52s.) £10 1/2—11 1/4	(50s.) £10 1/8—11 1/8	(52s.) £10 1/2—11 1/4	(75s.) £11 3/8—12 1/8	(75s.) £11 3/8—12 1/8
Italy Lire 23,000 per metric ton	(30s.) £14 1/8	(28s.) £14 1/4	(25s.) £14 1/8	(55s.) £15 1/8	
Canada $20 ex-works	(60s.) £15	(60s.) £15	(60s.) £15	(70s.) £15 1/2	(60s.) £15

Freight indications ( ) have been reduced to f.i.o. terms to provide a common basis for comparison.

rates of brimstone and pyrites to the Continent, as shown in table, remain below those to the United Kingdom although in the present state of the market the gap has narrowed.

Supplies

Frasch sulphur output in the United States of America continues to be held in check to avoid an undue rise in stocks. Seasonal decline of consumption during the summer months has been accentuated by a setback in sulphur usage. Imports of Mexican brimstone and added output of recovered sulphur reduces domestic outlets, but United States Frasch suppliers are successfully maintaining their position in export markets.

In Mexico Frasch sulphur output rose during August and September as the result of additional wells being put into operation. The level of operation by the three producers, Pan-American Sulphur Co., Gulf Sulphur Corporation and Texas Gulf Sulphur Co. of whom the last mentioned company has not yet affected deliveries, is reported to be at a daily rate of 3,300 tons rising to 4,300 tons.

Production in Italy of fused sulphur is being further reduced, while the reported further expansion of production facilities of sulphuric acid based on sulphur ores and concentrates is strengthening the mining side of the industry. The effect of the last twelve months successful disposal by Ente Zolfi Italiani of 173,000 tons fused sulphur on export markets appears to have reduced the stockpile held by Ente Zolfi Italiani in warehouses to less than 200,000 tons of varying grades.

In Chile sulphur production is being severely curtailed as no exports have been possible at prevailing production costs and the condition of the foreign exchange market. Domestic consumption of about 25,000 tons per annum permits limited operation of the major mines amongst which Azufrera Aucanquilcha remains prominent.

Recovery

Output of recovered sulphur at Lacq by Société National des Petroles D' Aquitaine is being maintained at the monthly rate of about 5,000 tons of high purity brimstone (99.95% S). The construction work on the second stage of the gas cleaning and sulphur recovery installation is progressing on schedule so that by the second half 1958 total capacity of 300,000 tons sulphur may be expected to come on stream.

The continued low levels of operations of the zinc industry in the United States and to a lesser extent in Europe has resulted in a slight curtailment of by-product acid supplies. Sulphur and by-product acid recovery from coal gas also receded slightly as the result of seasonal factors.

Pryites

Consumers of pyrites on the Continent are taking advantage of low freight rates and shipments of Spanish, Portuguese and Cypriot pyrites exceed seasonal levels. The earlier advances in mine production are being maintained and no noticeable reductions in mine stocks is reported to have occurred, while consumers stocks on the Continent are rising. In the U.K. despite the resumption of pyrites use by a small number of favourably sited plants, the trend towards greater brimstone use is being maintained. In view of the high level of consumer and Government stocks and the likelihood of further reduction in pyrites consumption, a substantial decline in imports is anticipated after the end of this year. Important progress is reported from Italy where Soc. Montecatini is now reaping the benefit of long term modernisation plans. At the Maremma mines, which yield pyrites of exceptional quality, output has risen to an annual rate of over $1\frac{1}{4}$ million tons, one of the largest individual productions in the world. The inprovement in the competitive positions of pyrites on the Continent may be expected to continue, but production costs of many producers of crude pyrites, notably in Spain and Norway, are reported to be increasing.

UNITED STATES SULPHUR

Frasch Sulphur

Production of Frasch sulphur during the second quarter of 1957, which totalled 1,330,329 tons, was 76,500 tons (5½%) smaller than in the previous quarter, and 282,000 tons (20%) less than the corresponding period last year. The realignment of production with the level of sales has been forced on producers in order to avoid accumulating excessive stocks. Texas Gulf and Freeport Sulphur Companies are reported to have

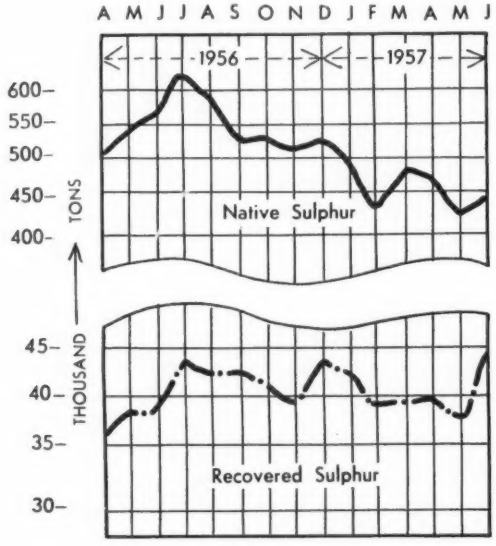


Fig 2. Monthly Production.

effected significant reductions in their output this quarter, and operations by the Standard Sulphur Company at Damon Mound has ceased altogether. Production at this dome commenced towards the end of 1953 at an annual rate of about 50,000 tons on a property which had been partly exploited by the Union Sulphur Company in the 1920's. The Company was declared bankrupt in May, and sulphur stocks were sold in order to meet the payroll. High operating costs for the small production, coupled with the depletion of reserves, are reported to be responsible for the company's failure. The plant is reported to have been bought by Texas International Sulphur Company for erection at the Texistipec dome in Mexico.

Apparent sales of Frasch sulphur, amounting to 1,470,026 tons, were 230,000 tons (18½%) greater than in the preceding quarter and only 17,000 tons (1%) lower than in the corresponding period last year, the peak period in 1956. Owing to the low level of Frasch sulphur sales in the first quarter, the total for the period January to June reached 2.71 million tons, compared with 2.96 million tons last year. Domestic consumption of about 2.43 million tons in the first half-year compares with 2.54 million tons in the corresponding period of 1955. Imports of Mexican sulphur continued to encroach upon domestic Frasch sulphur along the eastern seaboard, and during the second quarter reached a total of about 115,000 tons, compared with 110,000 tons in the previous quarter. The establishment of the stockpile of Mexican sulphur at Tampa, Florida, was favourably received by local sulphur users.

During the second quarter, 4.11 million tons sulphuric acid (100% H_2SO_4) was produced, raising the half-year's total to 8.12 million tons (8.24 million tons in 1956). The large volume of acid now being consumed by the titanium pigments and uranium-processing industries has tended to mask the lower level of demand from the iron and steel industry, which during the quarter operated at only about 87% of capacity, and the decline of activity in rayon manufacture. Acid demand for fertiliser production started to improve at the end of March, but this was not fully maintained. Despite the rapid depletion of stocks of both ammonium sulphate and superphosphate throughout the quarter acid demand by these industries was disappointing and superphosphate output was substantially lower than during the first half of 1956. Acid demand for use in phosphoric acid manufacture continues to increase and emphasises the trend in agriculture for the high analysis compounds.

Despite the lower level of utilisation of acid facilities in the half year four new acid plant projects* have been announced ; they are contact acid plants, three of which are based either wholly or partly on the use of sludge acid. In 1956 it is estimated that over three-quarter million tons of sludge acid was

* See Page 38.

consumed by the United States sulphur industry, and it is expected to increase at least 15% this year.

Brimstone exports during the second quarter totalled 457,382 tons, compared with 290,082 tons in the preceding quarter. Intense competition from Mexican sulphur producers in all export markets has resulted in some losses of tonnage. These reductions have, however, not so far affected the overall status of United States exporters, mainly as the result of the expansion of their sales to Brazil, Western Germany, Finland, Sweden, Belgium and India.

Stocks of Frasch sulphur at the end of the second quarter totalled 4,086,614 tons, a slight decrease compared with the previous quarter's stocks, but over 770,00 tons more than in the corresponding quarter of last year, when stockbuilding had just commenced.

Recovered Sulphur

Production of recovered sulphur totalled 123,917 tons, 3,000 tons (2½%) greater than the previous quarter, and 11,000 tons (9½%) greater than the corresponding period last year. The oil refining industry continues to raise its level of production and the greater emphasis on the production of high-grade petroleum is resulting in the greater use of catalytic cracking and the consequent arising of hydrogen sulphide. Sulphur recovery facilities are likewise undergoing expansion.

Important new projects were initiated at Linden, N.J., and Baytown, Texas. The General Chemical Division of the Allied Chemical & Dye Corporation is installing a 60 tons per day unit at Linden, New Jersey. This will recover H_2S from the Bayway refinery of the Esso Standard Oil Company of New Jersey. At Baytown, Texas, the recovery unit under construction for Consolidated Chemical Industries Division of the Stauffer Chemical Company will double the capacity of the existing sulphur recovery unit and the installations will then be capable of recovering 150 tons per day of high purity elemental sulphur. It will be based on feed stock from the adjacent catalytic cracker of the Humble Oil & Refining Company which is now under construction and is anticipated to enter production early next year. Construction work on the recovery plants of the Anlin Company at Perth Amboy, N.J., and the American Oil Company at Yorktown, Va., are progressing rapidly and are expected to come on stream before the end of this year.

Apparent sales of recovered sulphur totalled 91,069 tons, a decline of 37,500 tons (29%) compared with the previous quarter and 29,000 tons (24%) less than in the corresponding period last year. The sharp fall in sales caused producers stocks to increase and these reached a record level of 144,753 tons, 31,000 tons greater than at the same time last year.

Summary

(a) During the second quarter domestic sulphur production totalled 1,454,246 tons, 5% less than in the previous quarter, so that in the first six months output was reduced to an annual rate of 6 million tons to accord with the current rates of consumption.

(b) Production of recovered sulphur at an annual rate of one-half million tons continued to advance.

(c) Apparent sales of Frasch and recovered sulphur totalling 1,561,095 tons during the second quarter were 14% higher than in the previous quarter. Sales to the home market in the first six months have declined 8½% compared with the corresponding period last year while exports of 747,464 tons held at about the same level. Domestic consumption has also declined and in view of greater imports of Mexican sulphur domestic sales of Frasch sulphur have been seriously affected.

(d) Imports from Mexico in the first half-year reached a total of about one-quarter million tons. The establishment of a stockpile at Tampa, Florida, is attracting custom and a similar stockpile on the Atlantic seaboard is now being built up.

The rising level of Mexican sulphur imports and their effects on U.S. sulphur sales has prompted Representative F. E. Hebert, Democratic Congressman for Louisiana, to introduce a measure demanding a 25% tariff on all sulphur imports. Mr. Hebert claimed that Mexican sulphur was being produced with cheap labour and shipped at lower costs and was in fact being " dumped in large quantities " on the United States domestic market. This measure is not expected to be enacted.

The impact on the United States sulphur industry of the recent cut in prices is discussed in detail on Page 15.

SULPHUR IN MEXICO

AFTER a brief pause in the Spring of this year the Mexican Frasch sulphur industry has resumed the expansion of its production potential. This steady progress towards the targets set for the next few years has now come to be expected from the industry which by the vigorous and successful conduct of its affairs has, in little over two years, established itself all over the world and especially in the U.S.A., as a serious competitor of U.S. Frasch sulphur.

The various developments at the three active sulphur domes—Jaltipan, Las Salinas and Nopalapa—are intended, as detailed below, to raise the level of output by over 1,500 to about 4,300 tons per day. The lion's share of this expansion is being undertaken by the Pan American Sulphur Co. whose Jaltipan dome already accounts for about 70% of production. Developments at the Las Salinas dome of Gulf Sulphur Corporation are designed to raise its daily rate of production to 1,000 tons brimstone. At present only these two producers effect deliveries of Frasch sulphur to home and overseas markets, as Texas Gulf Sulphur Company's output in Mexico is not as yet being marketed. Following the failure of Mexican Gulf Sulphur Company, there is now only one other company actively engaged in a Frasch sulphur project namely Texas International Sulphur Company which is planning to start its operations at the Texistipec dome next year.

During the first six months of this year the Frasch sulphur industry of Mexico produced about one-half million tons brimstone of which about four-fifths was shipped to consumers at home and abroad. Brimstone exports totalling 398,732 metric tons of which 57% was destined to U.S.A., are now making a useful contribution to Mexico's foreign trade balance and it is estimated that at about $9½ million they accounted for 2% of the value of Mexico's total exports during the first half year.

A threat by a labour leader, Señor Eduardo Fernandez to demand nationalisation of sulphur production has been ignored in official quarters and discounted by the members of the industry. It is widely recognised that the steady flow of private capital, mainly from the U.S.A. is essential for the maintenance of the impetus of the initial development of the industry. Moreover, the tangible benefits enjoyed by the sulphur mining areas in the form of generally rising living standards and as the result of the provision of medical and social facilities by the mining companies are the acknowledged corollaries of successful private enterprise.

PAN-AMERICAN SULPHUR COMPANY

At present the mainstay of the Mexican Frasch sulphur industry, the company reports a continued satisfactory expansion of output and sales during the first half of 1957. As shown below in the data extracted from the half-yearly report the outstanding feature is the proportionately greater advance in net income.

Texas Gulf Sulphur Co. Storage vats at Nopalapa; barge mounted plants in background.

	1957	1956
	January—June	
Production	347,000 tons	257,000 tons
Deliveries	309,000 tons	154,000 tons
Net Income	$1,637,692	$699,893
Net Income per share ...	U.S. Cent 82	U.S. Cent 35

The rate of production which over the periods under review increased 35% is to be raised by a further 16% during the second half-year in order that the planned output for 1957 of three-quarters million tons should be achieved. Output is being raised from the present average of 2,000 tons per day to 3,000 tons, by the addition of five new wells which entered operation in September when the second collecting and relay station came on stream. Hitherto, operations based on about one-third of total water capacity originated from ten wells and the new station is capable of handling a similar number. Current output is wholly in the form of filtered sulphur which is reported to show consistently 99.7% sulphur, 0.24% carbon, 0.05% ash and 0.01% moisture.

Following the record rate of deliveries in the first half year, which represented a 100% advance on the same period of 1956, the third quarter's shipments were expected to be even greater at 180,000 tons and the year's results should be substantially in excess of 600,000 tons. The company's one millionth ton of brimstone was shipped in the last week of September, nine months after the millionth ton was produced. It is the Company's policy to expand mine stocks in keeping with the growth of production and commitments. Stocks at the end of July reported to total 530,000 tons.

The outstanding success in the company's sales policy has been the establishment of a stockpile in Tampa. The service so rendered to the U.S. fertiliser industry, which in this area is represented by all the major phosphatic fertiliser producers, has resulted in substantial savings on its sulphur expenditure not counting the very competitive price at which sales ex-stockpile are being effected. Transport from the stockpile is by heavy lorries, which having carried phosphate to Tampa make their return journey, hitherto unremunerative, laden with sulphur. A similar development is in progress along the eastern seaboard.

In anticipation of the results of the very intensive sales effort all over the world, mostly in the U.S.A., U.K., Europe, North and South Africa, India and Australia the company has pressed forward with the construction work on its second loading pier at Coatzacoalcos. Expected to be completed towards the end of October the loading rate of the new installation will exceed that of the existing one which is rated at 500 tons per hour. Waterside storage facilities will also be expanded—to 70,000 tons.

TEXAS INTERNATIONAL SULPHUR

Development work at the Texistipec dome and adjacent properties is reported to be progressing and showing encouraging results in respect of potential sulphur reserves. The preparatory work at the site of the projected 1,000 tons per day Frasch sulphur plant which was to be built by Fish Engineering Services, is said to be completed. Instead, the company is reported to have purchased the mobile Frasch sulphur plant which had been operated by the Standard Sulphur Company—now bankrupt—at Damon Mound, Texas. The plant, which has an annual capacity of 50,000 tons sulphur, is being shipped forthwith and is due to enter production early in the New Year.

GULF SULPHUR CORPORATION

Following extensive studies which the company's technical management pursued for several months, the drilling of new production wells was started at Las Salinas dome early in August. Previously production had originated from seven wells and as some, as is customary, were not being pumped constantly, the daily output rate had been held at an average of about 500 tons. The first of three new wells came on stream in the last week of September, and this development was accompanied by the installation of two additional high-power air compressors. Conservatively the new production wells are estimated to yield 300 to 400 tons per day brimstone and it is anticipated that in the course of the coming months a production level of 1,000 tons per day will become customary.

The company's exports during the first six months were directed principally to the U.S.A. where two-thirds of total shipments of 54,888 metric tons was placed.

TEXAS GULF SULPHUR COMPANY

Early in July the level of production at the Nopalapa dome (Santa Anita) was nearly doubled and the new monthly output rate of about 8,500 tons is reported to have been maintained. The plant which is mounted on two barges gives a satisfactory performance; as yet there are no facilities for filtering the crude sulphur output which is

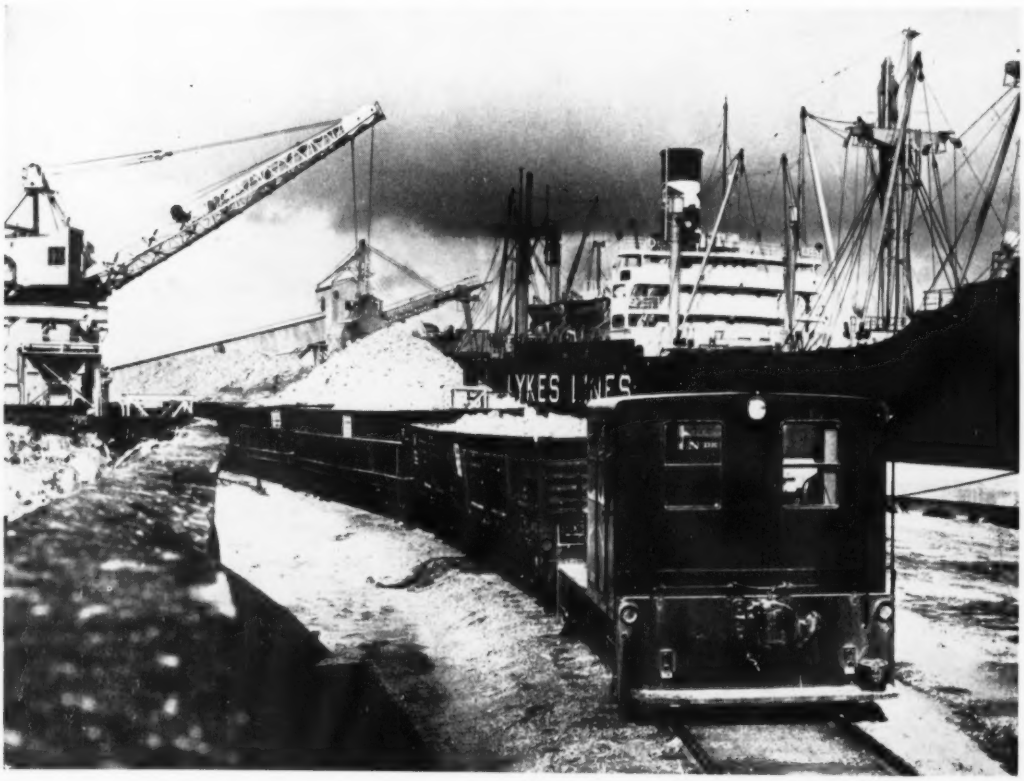
reported to be off-colour. Cia Exploradora del Istmo, the Mexican operating company, have not so far effected any deliveries and the entire output is being stockpiled. A new dock is said to be under construction at Coatzacoalcos.

MEXICAN GULF SULPHUR COMPANY

Early in July the exploratory work* on the Nopalapa concession of Texas International Sulphur, where the *Mexican Gulf Sulphur Co.* had drilled over 30 wells, had to be abandoned. Some wells had disclosed traces of sulphur, but the survey failed to disclose an indication of a commercial dome deposit and thus the projected use of the idle Frasch plant at San Cristobal for the joint exploitation of the dome with Texas International Sulphur Company at this nearby site did not materialise. This imaginative project was to have linked the two companies' fortunes by an exchange of shares. Its failure appears to have caused the Export-Import Bank, the company's principal creditor, to foreclose on their loan and to take a lien on the plant and installations in Mexico, the future of which is at present in abeyance.

Summary

Already this year Mexican production will exceed one million tons and installed facilities are designed for a 50% increase next year. The anticipated advent of a fourth producer, coupled with the full use of the potential capacity of the domes now operating, should lead to an annual availability of two million tons Mexican Frasch sulphur from 1960 onwards which implies a corresponding development of overseas markets. The problems of price and serious competition from the U.S. Frasch sulphur industry and especially after 1960 of the vastly expanded world resources of recovered sulphur are discussed in detail on page 15. Following an impressive start, the Mexican industry is in a position to stand up to strong competition, which in view of the importance of securing a sizeable share of the U.S. market is likely to remain secure.



Pan American Sulphur Company. Loading installations at Coatzacoalcos.

* See Bulletin No. 17, Page 18

UNITED KINGDOM SULPHUR

Sulphur Supplies

Brimstone: Imports of elemental sulphur during the second quarter 1957 amounted to 76,759 tons and compared with the preceding quarter they were 9,000 tons (13%) less. The decline is partly attributable to the smaller volume of charters effected during the period of peak freights early in the year and also to the impact of brimstone supplies from Government stockpiles which are being liquidated and made available to industry. The average cost of imports during the second quarter was £16 per ton compared with £15 13s. in the preceding quarter. Supplies originating from stockpile are becoming available at current market prices less modest discounts mainly on account of quality.

The disposal of the stockpile, which originally totalled about 85,000 tons, is progressing satisfactorily and the Board of Trade is receiving full co-operation from the trade and industry. "Regular" sulphur supplies which account for about two-thirds of the volume are being distributed through the original importers, the agents of the U.S. Frasch sulphur producers, whilst "acid" sulphur is being distributed through the National Sulphuric Acid Association.

Production of recovered sulphur in the second quarter declined sharply to 6,700 tons compared with 11,300 tons in the preceding quarter. The effect of the closure of the Suez Canal last winter, which entailed a significant reduction in the use of Middle East sour crudes at oil refineries and at the same time the building-up of sizeable stocks of Venezuelan sweet crudes was being felt. At the prevailing level of refining activity, this phase passed quickly allowing the higher rate of sulphur recovery to be resumed.

Pyrites: Imports of pyrites during the second quarter totalled 100,873 tons. The increase of 52,500 tons compared with the first quarter does not accord with a change in the rate of consumption nor does the stock position warrant it. It is believed to be due to technical reasons connected with the availability of shipping space in relation to the contract tonnages. The average import value of £8 per ton is the highest on record, and compares with £7 17s. in the preceding quarter. Cyprus is the main supplier accounting for about 60% of the first half-year's imports and Spain for about 30%.

Anhydrite: Production of anhydrite for sulphuric acid manufacture was maintained at the high rate of 176,277 tons corresponding to the intensive activity of the four anhydrite acid plants.

Spent Oxide: Under the progressive rationalisation and modernisation programme of the town gas industry an increasing volume of spent oxide is becoming available. Purification of coke-oven gas, where this is being supplied to the gas grid, is also increasing with the result that only a part of the physical output is used in acid manufacture. In the second quarter this totalled 68,389 tons. The modest exports of spent oxide which were directed to France and Holland in recent months declined as they are no longer competitive abroad.

Zinc Concentrates: The manufacture of by-product sulphuric acid from SO_2 in smelter gases at the Avonmouth and Swansea works of National Smelting Corporation declined in unison with the lower level of metallurgical activity occasioned by the reduced demand and price level for the metal. Enhanced operation of stand-by brimstone burners ensured adequate acid supplies for the internal chemical operation of the company and its associates.

Stocks: Stocks of "regular" and "acid" sulphur — imported and recovered — totalled 104,100 tons representing 12 weeks supply at current rates of usage. The level of distributed stocks which include filter cake has not so far shown a significant change over the past year. Stocks of pyrites of 213,500 tons represents 30 weeks' supplies and in addition to these heavy distributed stocks there is considerable tonnage of pyrites held by the Board of Trade awaiting disposal. Stocks of spent oxide at the end of June totalled 116,300 tons, 11% less than at the beginning of the year.

Consumption

During the second quarter 1957, United Kingdom consumption of sulphur in all forms* totalled 238,000 tons, representing an increase of 8,000 tons (3½%) compared with the corresponding period of last year. The acceleration of general industrial activity in May and June is reflected in the reduced seasonal effect on sulphur usage which was only

* Excluding sulphur in anhydrite consumed in the direct manufacture of sulphate of ammonia and estimated to total 210,000 tons per annum.

9,000 tons (3½%) lower than the peak level of the first quarter. The seasonally adjusted index (1948 = 100) during the second quarter rose to 141, from the plateau of preceding months, and although it may mask the finer fluctuations of individual sectors of the economy, it adequately portrays the trend in sulphur using industries.

Imported sulphur supplies accounted for 60% of the above tonnage of which brimstone represented 41%, pyrites 18% and filter cake about 1%. Indigenous resources, including sulphur in anhydrite, spent oxide and zinc smelter gas, and sulphur recovered from coal and oil refinery gases, account for the remaining 40%.

Brimstone consumption, including H_2S and filter cake, totalled 113,500 tons, the second highest tonnage on record and resulting in the first six months usage attaining an annual rate of 458,000 tons. The slight decline of acid sulphur usage—under the influence of seasonal factors—was partly compensated by a modest increase in the use of "regular" sulphur.

Details of consumption are as follows :—

	2nd Qtr. 1957	*1st Qtr. 1957*	*% Change*	*2nd Qtr. 1956*	*% Change*
Elemental Sulphur :					
Acid : Imported	75,400	75,800	− ½	62,400	+20¾
Recovered, H_2S and Filter Cake	9,100	10,900	−16½	9,600	− 5¼
Total "Acid" Sulphur	84,500	86,700	− 2½	72,000	+17½
Regular	29,000	28,700	+ 1	29,000	—
Total Elemental Sulphur	113,500	115,400	− 1¾	101,000	+12½
Pyrites	92,200	95,900	− 3¾	107,300	−14
Spent Oxide	68,400	68,700	− ½	63,400	+ 8
Anhydrite	176,300	188,800	− 6	169,300	+ 4¼
Zinc Concentrates	37,800	52,300	−10½	43,600	—13¾

Compared with last year, elemental sulphur use had increased 12%, while the use of sulphur in zinc smelter gases fell by 13¼%. Pyrites use of 92,200 tons, although 14% lower than at the same time last year, has not yet stabilised at its new level of consumption which is believed to be 10-15% lower. The consumption figures of spent oxide of 68,400 tons mask the increased usage at integrated works such as the major gas works, notably in the London area, and the new Avenue plant of National Coal Board, which more than compensated for the termination of spent oxide use at several plants in the North-West caused by the inroads into the market of new anhydrite acid and brimstone acid. Anhydrite consumption at 176,300 tons during the second quarter remained high.

"Regular" Sulphur : The recovery in the man-made fibre industry, the largest individual "regular" sulphur user raised consumption from the depressed state of last autumn without, however, exceeding the level of usage during the first half-year of 1956. The start of operations of Messrs. Courtaulds new staple fibre plant at Grimsby boosted May production to 25.9 million lbs., while filament output of 23 million lbs. contributed to a record total of 48.9 million lbs. A rising proportion of current output, estimated to account for at least 8%, is, however, synthetic fibres. Increased activity in tyre manufacture is reported to have resulted in a slight increase in sulphur needs for rubber compounding while greater activity in the manufacture of sulphur dioxide and sulphites expanded these relatively smaller outlets.

Sulphuric Acid *

Production of sulphuric acid totalled 586,758 tons (100% H_2SO_4), an increase of 4½% over the second quarter 1956. It resulted from the use of the following raw materials :—

	2nd Qtr. 1957 %	*1st Qtr. 1957* %	*2nd Qtr. 1956* %
Elemental Sulphur			
Imported Brimstone	36	34¼	31
Recovered, H_2S, Filter Cake	4½	5	4¾
Sulphur in:—			
Pyrites	21	22½	25¼
Spent Oxide	15½	14¼	15
Anhydrite	17¾	17½	17½
Zinc Concentrates	5½	5¼	6½
Total Sulphur 000 tons	209	219	202

Brimstone acid further increased its share of total output and now represents 40½% of the above tonnage. The closure of several small

* We are indebted to the National Sulphuric Acid Association for information placed at our disposal.

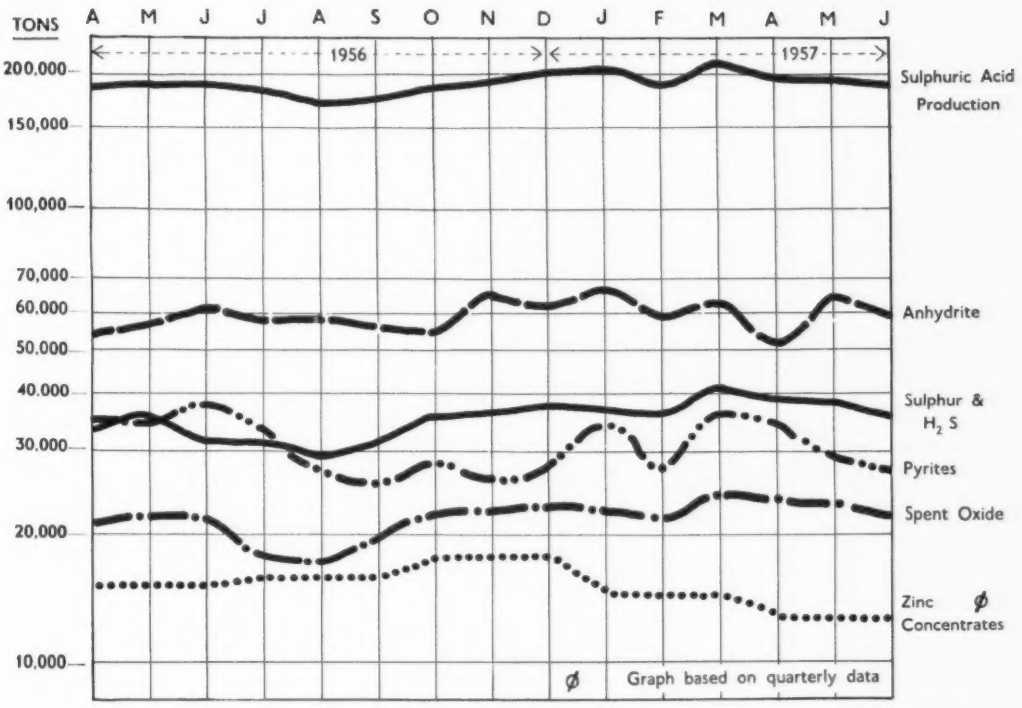


Fig 3. Monthly consumption of raw materials including regular sulphur and production of sulphuric acid.

plants in Scotland and the discontinuation of pyrites use by several major users is reflected by the decline in the output of pyrites acid now only 21% of the total. Production of sulphuric acid by the contact process continues to expand and in the second quarter accounted for 76½% of total output. This trend is attributable to the growing volume of new plant and is emphasised by a comparison with 1952—prior to the major plant construction programme—when only 62% of a substantially smaller tonnage of acid was so produced. Total capacity represented during the second quarter amounted to 698,700 tons (100% H_2SO_4) of which 84% was used. By comparison employment in the preceding quarter was 86½% of a fractionally larger available acid capacity.

Sulphuric Acid Consumption

Consumption of sulphuric acid during the second quarter 1957 amounted to 582,565 tons (100% H_2SO_4) was the highest on record for this period and 4¼% greater than in the second quarter 1956. Although reduced consumption for superphosphate manufacture –down 9%— is partly compensated by greater (4¾%) requirements for ammonium sulphate manufacture, there is an overall decline of acid used for fertiliser manufacture. In the second quarter of 1956 fertilisers used 36.9% of the total whereas the 197,200 tons (100% H_2SO_4) used this year represents only 33.8%. This is in contrast with the consistently rising volume of acid consumed in the manufacture of pigments notably titanium dioxide, viscose rayon and film and detergents. In these sectors of industry the volume of acid usage increased from 156,100 tons (100% H_2SO_4) representing 27.9% of total consumption in the second quarter 1956 to 177,200 tons, representing 30.4% of the greater total consumed this year. To meet further increases in acid consumption for titanium dioxide manufacture additional plant capacity is foreseen by the two producers, Laporte Titanium Limited and British Titan Products Limited. The rise in acid use in the rayon industry is partly due to the increase in high tenacity yard production, notably for the

tyre industry, and also to the recent expansion of staple fibre production capacity following the start of operations of the Grimsby plant of Messrs. Courtaulds Limited. This has not been accompanied by the installation of new capacity but acid is brought in mainly from the company's own plant at Trafford Park, Manchester.

Acid usage by the main consumer groups in the two periods was as follows :–

	2nd Qtr. 1957		*2nd Qtr. 1956*	
	000 tons	*%*	*000 tons*	*%*
Fertilisers	197.2	33.8	206.0	36.9
Chemicals	78.5	13.5	74.9	13.4
Titanium Dioxide and Lithopone ...	78.5	13.5	72.1	12.9
Rayon and Transparent Paper	76.4	13.1	64.8	11.6
Metallurgy ...	33.0	5.7	31.6	5.7
Oil Refining ...	15.4	2.7	15.7	2.8
Dyes	23.7	4.1	19.1	3.4
Soaps & Detergents	22.3	3.8	19.2	3.4
Miscellaneous ...	57.6	9.8	53.5	9.9
Total ...	582.6	100.0	558.9	100.0

Principal changes in individual consuming industries compared with the corresponding period in 1956 were as follows :—

	Change	
	tons	*%*
Superphosphate	– 12,300	9¼
Rayon & Transparent Paper ...	+ 11,600	18
Titanium Dioxide	+ 6,600	9¼
Dyestuffs & Intermediates ...	+ 4,700	24½
Sulphate of Ammonia	+ 3,400	4¼
Soap, Glycerine & Detergents	+ 3,200	16¼
Iron Pickling	+ 1,500	5

Quantitatively smaller, but nevertheless important changes, occurred in bromine (+23%), explosives (−16%), plastics (−11¼%), tar and benzole (+22%), and textile uses (−10½%).

The main features of the U.K. sulphur industry in the second quarter 1957 are as follows :—

(a) The high level of the consumption of sulphur in all forms of 238,000 tons, reflecting the acceleration of industrial activity.

(b) Seasonal record output and usage of sulphuric acid induced mainly by the rapidly expanding needs of industries other than fertiliser.

(c) The further growth of the proportion of brimstone acid to 40½% partly at the expense of pyrites usage and more recently of by-product acid owing to lower zinc smelter activity.

(d) The highest ever import cost (per ton) of brimstone and pyrites.

During the summer months the sulphur industry reflected the relatively higher level of industrial production, and sulphuric acid manufacture, in particular, showed seasonal decline that was less pronounced than in other years. In contrast with this satisfactory development on the production side, was the increase in the price of sulphuric acid which became operative in August and averaged 10s. per ton. Although the rising cost of labour and the incidence of overheads have been increasingly felt by producers, it is understood that the principal reason for the increased price of acid was the high cost of imported brimstone and pyrites in the preceding months mainly due to the prolonged adverse effect of inflated ocean freights.

Courtaulds Limited. New staple fibre plant at Grimsby.

SULPHUR IN ITALY

THE unanimous decision taken at the plenary meeting of Italian sulphur producers at Palermo on 23rd September threatening to close all Sicilian mines if the Government authorised the temporary imports of cheap sulphur from the United States or Mexico serves as a jolting reminder that the basic problems of the industry remain unresolved. Since the Autumn of 1955, thanks to the Central and Regional Governments' financial support in the form of production and export subsidies, the forceful policy of the Ente Zolfi Italiani has enabled the industry to resume competitive exports to selected markets. This aspect of its activities depended on the prevailing stability of international sulphur prices while the fluctuation in trans-Atlantic freights allowed the Ente Zolfi Italiani management to employ the limited subsidy resources to the best advantage. A great weakness, however, was the producers and Governments reliance on the continued willingness of the domestic brimstone users to pay without subsidy the high cost of the home production. In recent years the price paid by them has been generally double and sometimes three times as much as the notional cost of United States or Mexican imported Frasch sulphur and since the introduction of export subsidies up to three times as much as foreign buyers of Italian sulphur. The important rayon industry headed by S.N.I.A. Viscosa found the burden especially heavy as it penalised its own ability to compete abroad. After consumer representations earlier this year, a Senate Committee approved a two year subsidy of about £¼ million per annum to bridge the difference in the cost of sulphur used in the manufacture of man-made fibre goods destined for export. It is not clear what aspect of this draft law the rayon industry did not consider adequate, but negotiations were recently reported to be progressing for the import of 35,000 tons cheap Frasch sulphur under a temporary system enjoying the Italian Government approval.

Production and Development

Progressive reduction of fused sulphur production is accompanied by the increased use of crude ores and concentrates in sulphuric acid manufacture. Compared with a monthly rate of production of about 20,000 tons fused sulphur in the Autumn of 1956 the level of operations in recent months was barely 14,000 tons. The introduction on a trial basis at the Irpinia mine of the new refining process developed by Professor Roma and the satisfactory results of over one year's operations of the Montecatini-Lurgi refining plant at Pertiçara hold promise that—provided investment capital becomes available—the application of efficient refining methods might remove one of the industry's weaknesses. For the time being, however, the main emphasis is on mine modernisation and the reduction of the prime cost of ore production. To this end the Technical and Planning Section of Ente Zolfi Italiani under the direction of Dr. Gianfranco Musco has initiated negotiations with a group of German finance and mining companies comprising Hochtief A.G. of Essen, Vereinigte Unter Tag und Schachtbau G.m.b.H. of Essen and the Rheinstal Industrie Planung A.G. of Düsseldorf. To implement the technical aspects of the plan and to provide the means, an agreement between the two countries' Governments is said to be under negotiation. At the same time, Professor Ing. Franco Lanza di Scalea together with Dr. Musco during a visit in July to Battelle Memorial Institute Laboratories at Geneva discussed with the Ing. Paquet and Tavel the possibility of Battelle conducting research into the scientific and technical aspects of the weaknesses of the Italian Sulphur Industry.

The discovery of a major native sulphur ore deposit near Rome substantially increases known reserves. Situated in the Campagna, near the settlement of Pomesia the deposit extends over the distance of three miles and a width of nearly one thousand yards. Lying beneath an over-burden of 20 feet, it promises to permit low cost mining. Its potentialities are being evaluated.

Deliveries and Exports

Preliminary details of the results achieved by Ente Zolfi Italiani for the financial year ending 31st July, 1957, indicate that domestic sales remained unchanged while exports rose 89%.

Deliveries to:	*1955*	*1956*	*1957*
Domestic Users	107,920	117,079	117,690
Export	10,158	91,576	172,987
Total ...	118,078	208,655	290,677

Exports during the year ended 31st July, 1957, were directed to:

France	51,445
Israel	35,420
U.S.S.R.	24,206
Tunisia	22,640
Sweden	7,580
Yugoslavia	6,923
Czechoslovakia	5,102
Others	19,671
	172,987

The substantial excess—more than 100,000 tons of deliveries over production enabled the Ente Zolfi Italiani to reduce the stockpile to about 200,000 tons fused sulphur of various grades. Mine deliveries of crude sulphur ore for sulphuric acid manufacture are reported to be running at an annual rate of 400,000 tons ore containing about 100,00 tons sulphur, half as much as one year ago. The expansion of this form of sulphur supply, if possible in substitution of pyrites imports, would seem to be in the interest of the economy as there is little prospect of maintaining the level of revenue from pyrites and brimstone exports. The latter totalled L.2.7 billion in the first half of 1957 compared with L.1.1 billion for the period January-June, 1956, as exports rose from 45,165 to 96,187 tons. Moreover, the need for the high level of cupreous pyrites imports seems to be diminishing as Soc. Montecatini is increasing output of this grade of ore.

Outlook

The reduction by $3 per ton of the export price of United States brimstone once more destroyed the competitive ability of Italian sulphur at present levels of subsidy. This has been aggravated by the weakness of the freight market which reduced the differential between trans-Atlantic and local freight costs. However illogical a policy of importing sulphur into Italy may appear the prevailing differences between domestic and international sulphur prices gives it a basis of economic reality.

With the expansion of recovered sulphur facilities in Western Europe especially in France the export outlets are being progressively restricted and it is anticipated that this development may soon affect even the domestic market. The two major oil refineries being installed in Sicily are to have a combined recovery potential of 100,000 tons high purity brimstone, and several of the existing oil refineries which in the past have flared H_2S arising in refining operations, are now said to be planning sulphur recovery facilities.

When the Italian Native Sulphur industry embarked upon its rationalisation and modernisation programme it envisaged a tranquil period of transition. Now that competitive world supplies encroach even up its domestic market, it is confronted with the harsh reality of having to act quickly. The moment is propitious as the greater diversity of industry in Sicily is beginning to remove the sulphur industry's main handicap, namely the sociological and political aspect of being the only major industrial employer on the island. To avert the threat of virtual eclipse of the Italian sulphur industry the speedy reappraisal of its future function is thought necessary which should be accompanied by the acceptance that any Government funds made available for subsidy should be applied only to strengthen the competitive position of the most economic enterprises. In the assessments of its new economic orbit centred on the mines of central Italy and Sicily, the advent of the Common Market may exert a salutary influence. By intergrating the potential of the native sulphur industry with that of pyrites in meeting the progressively expanding needs of Italian sulphur users, notably in the manufacture of sulphuric acid and fertilisers, its tradition and extensive resources might be prevented from being wasted.

SULPHURIC ACID IN THE PHILIPPINES

IN the expansion of industrial activity in the Philippines since the war, the development of the country's mineral deposits and the emphasis placed by the Government on increasing food supplies and agricultural production have played a major part. Wealth of primary materials notably ores and metals, is causing Japan to regard it increasingly as a source of supply, and the number of projects which owe their conception to the interest of this vast market, little more than 1,600 miles to the north-east of Manila, is growing constantly. Industrially it is one of the most advanced in the Western Pacific Ocean, with the United States providing a large volume of investment capital and technical information. One of the highlights of the present phase of industrial expansion is the development of the

copper mining industry. These projects have a direct bearing on the country's sulphur industry, as the manufacture of sulphuric acid, from by-product pyrites and from sulphur in smelter gases, and its subsequent use in the production of fertilisers are integrated with the metallurgical operations. At present, plans are in hand for three acid fertiliser projects based on the use of by-product pyrites concentrates and two copper smelters are also planned. Until 1953 there was no manufacture of sulphuric acid and the islands small requirements were met by imports alongside with the fertiliser needs. In 1956, sulphuric acid production totalled 44,029 metric tons (100% H_2SO_4) slightly less than in the previous year. Of this total 43,200 tons pyrites acid was produced at the Maria Cristina plant of the National Power Corporation at Ilagan City, Mindanao Island, the remainder being produced at the small sulphur burning plant of the Chemical Industries of the Philippines Inc.

National Power Corporation. Pyrites acid plant under construction (1955). Brimstone burner right background.

Sulphuric Acid Production

The Maria Cristina plant at Ilagan which has an annual production capacity of 50,000 tons of ammonium sulphate started operations in 1953 and is the country's first major fertiliser installation. Sulphuric acid is obtained from the integrated Chemico contact plant which has the capacity to produce 120 metric tons per day (100% H_2SO_4) in the form of either 93% or 98% acid. The plant was originally designed to burn Texas bright sulphur and also used indigenous volcanic sulphur (56½%S) supplied by the Camiguin Mining Company from their deposit at the foothills of the Mount Camiguin Volcano at a rate not exceeding 2,000 tons per year. With the development of indigenous sources of by-product pyrites the National Power Corporation initially based its operations on supplies from the Hixbar Gold Mining Co. at a rate of 10,000 tons and the Company's additional requirements are being obtained from the Atlas Consolidated Mining and Development Corporation. Trial shipments of the concentrates from this source so far total 10,000 tons and it is anticipated that a contract will be placed for about 3,000 tons of concentrates per month.

In the light of Government policy to reduce import of fertilisers which in 1952 included a record total of 136,000 tons ammonium sulphate, the National Power Corporation, following the successful operation of the Maria Cristina plant and disposal of its output, recently called for tenders for a second ammonium sulphate plant. This is to be capable of producing 150 metric tons per day of crystalline sulphate and is to consist of an electrolytic hydrogen plant, nitric acid and ammonium synthesis units and a sulphuric acid plant. The latter has a designed capacity of 130 tons (100% H_2SO_4) in the form of 98% acid and is based on the use of "sulphur bearing ores" presumably by-product pyrites.

Acid/Fertiliser Project

The most important project is that of Atlas Consolidated Mining and Development Corporation, whose activities are centred on the low grade (less than 1%) copper deposits at Toledo, Cebu Island, which is the largest open-cast copper mine in the Orient. The original crushing installations at Toledo with a capacity of 4,000 tons per day of ore were completed in April, 1955, but has since undergone two expansions so that the plant is capable of treating in excess of 10,000 tons per day of ore. The initial analysis of the ore, indicated that by-product pyrites could be produced at a rate of about 600 tons per day from 10,000 tons of ore but subsequent operation of the mill has shown that output will be established at about 350 tons per day containing 40% to 48% sulphur when regular production starts. In 1956 production and sales of concentrates were as follows:—

	Production	*Sales*
	metric tons	
Copper Concentrates	58,277	41,229
Pyrites Concentrates	5,476	1,850

The production of pyrites concentrates was discontinued in 1957 due to the lack of a regular domestic market pending the conclusion of a contract with National Power Corporation and because negotiations to place by-product pyrites in European markets broke down on account of the rise in the sea freights.

The disposal of pyrites concentrates will be established on a regular basis when the company's own acid/fertiliser project starts operation towards the end of this year. This pyrites acid plant will have a consumption capacity of about 120 tons pyrites per day, leaving the balance available for sale.

Fig 4.

Construction work on the plant which is being built by St. Gobain, commenced in March, 1957, and imports of machinery from France are now virtually complete. It is anticipated that the sulphuric acid and fertiliser installations will be in production by the end of this year and operate at about its design capacity which is 15 tons per hour of single and triple super-phosphate and 18 tons per hour of granulated mixed fertiliser. The plant will produce its own phosphoric acid at the rate of 25 tons per day from imported phosphate rock but will depend on outside sources for the supply of other fertiliser materials.

Marinduque Projects

The most recent development in the copper industry in the Philippines has been undertaken by the Marinduque Iron Mines Agents Incorporated, who have sponsored projects at Sipilay and Bagacay. A 4,000 tons per day ore crushing and treatment plant entered operations early this summer and is producing concentrates from ore containing about 1% copper. The concentrates are shipped under contract to Japan to the Mitsui Metal Mining Corporation's smelter for refining. The Bagacay project in central Samar is potentially of greater importance and significant deposits of secondary enriched copper were discovered in August, 1955. Although no plans have yet been finalised it has been proposed to build an acid/fertiliser plant, which would be based on the pyrite ore deposits estimated at nearly half a million tons averaging 40.7% sulphur. The erection of a copper smelter is also envisaged.

Conclusion

The systematic geological survey of the Philippine Islands which, since the end of the war has been carried progressively further afield, and which has been aided by the Government support for the establishment of new industries, has resulted in impressive additions in many sectors of the base metal industry notably copper, iron, gold and mercury. The arising of by-product pyrites, a joint product in the production of copper concentrates, has enabled the Philippines to become self sufficient in their sulphur requirements which prior to this development were met mainly by the use of Frasch sulphur. The potential production capacity of by-product pyrites is more than ample to meet the country's need. Japan might find in these surplus pyrites concentrates a useful source of cheap sulphur, but otherwise it is doubtful whether they will find a way into international trade on account of market inaccessibility and the relatively high cost of freight rates in relation to the low value of the product. The new fertiliser projects provide ample capacity for the country's need. Based on indigenous sulphur and nitrogen supplies, these projects represent a corner stone in Government plans for the island's growing prosperity.

ELEMENTAL SULPHUR IN JAPAN

Production

Under the stimulus of unprecedented demand Japan's elemental sulphur industry in 1956 broke all previous output records by producing 247,582 metric tons. To achieve this level of operations, which represents an increase of 45,000 tons (22%) over 1955 and exceeds the previous peak output in 1937 by nearly 18,000 tons (7¼%) all active mines expanded their installations, a number of new deposits were developed and several closed mines resumed their activities. In particular the latter defies the economics of sulphur supply and appears to be the result of the Japanese sulphur producers desire to keep the need to import to a minimum. In this they undoubtedly had the Government's sympathy. Compared with 1955 when the number of active producers had declined to 24 it is believed that in 1956 it approached the peak number of 36 registered in 1953. Indeed, expansion was such that by the end of the year available capacity totalled over 300,000 tons. Actual output in 1956 was contributed by the following major producers:—

	1956	*1955*
	000 metric tons	
Matsuo Mining Company ...	76.3	62.3
Hokkaido Sulphur Company ...	39.7	32.0
Teikoku Sulphur Industry Co. ...	22.8	17.7
Akan Sulphur Mining Company...	22.7	20.0
Shirane Sulphur Company ...	12.8	11.2
Zao Mining Company	10.5	9.9
Others (less than 10,000 tons) ...	62.8	449.6
	247.6	202.7

This greatly increased and widely based activity owed its foundation to the agreement concluded early in April, 1956, between producers and consumers which provided for the orderly marketing of an agreed level of production. Designed to give producers an assured return of about 15% on the delivered price of sulphur, the price basis of 1956 was agreed at about 22,000 yen* per metric ton f.o.b. mine. Endeavours to improve the efficiency of operations and to reduce the costs of production were evident, principally on the part of the larger producers among whom the Matsuo Mining Company was again prominent. In spite of this under the impact of higher costs of power, steel, coal and basic raw materials and an increase in wage rates from mid-1956 onwards the cost of sulphur production rose to the highest ever level.

Imports

Notwithstanding the surprising expansion in output and capacity domestic supplies failed to meet the upsurge of demand. Under the agreement between the two sides of the industry, which gave producers valuable security, the consumers benefitted by the removal of objections to imports. Thus they were able, once the Government was satisfied that their need was genuine and not merely induced by the appreciably lower cost of imported brimstone, to obtain 23,000 tons from abroad. Owing to qualitative requirements purchases were confined to United States bright sulphur which is believed to have reached users 25-30% cheaper than domestic supplies.

Consumption

The boost to domestic sulphur consumption was mainly attributable to a further increase in the activities of Japan's man-made and synthetic fibre and her pulp industries. The former holds an important place amongst Japan's export industries and it is significant that last year under the stimulus of overseas demand, augmented by a growing home market, rayon staple fibre production achieved the ultimate target of a five-year plan in the plan's second year. Whilst Japan maintained her position as the largest staple fibre producer in the world she also strengthened her position in the fields of clothing and industrial fibres manufacture in which the use of sulphur played an essential part. The distribution of sulphur usage in 1956 was as follows:—

	000 Metric Tons		*Increase*
	1956	*1955*	%
Carbon disulphide ...	128.9	100.9	27½
Pulp	92.9	83.1	12
Synthetic Fibre ...	11.4	5.8	97
Other	22.0	13.4	64
	255.2	203.2	25

* Yen 1,009 = £1.

The growth of domestic sulphur usage of over 52,000 tons (25½%) compares with an expansion of 23,000 tons (13%) in 1955.

Export

Owing to excessive domestic demand and the need to subsidise exports if Japanese sulphur is to compete on world markets, emphasis on exports further declined. Compared with 5,792 metric tons supplied in 1955 principally to Australia, exports in 1956 are reported to have shrunk to 565 tons.

Developments in 1957

Curtailment of activities in the staple fibre industry of last April and similar measures in the rayon industry put into effect in August have been reflected in lower sulphur usage. In consequence the year's consumption picture is expected to show the following:—

	Estimates 1957 Metric Tons	*Change on 1956*
Carbon disulphide ...	125,000	−2½%
Pulp	90,000	−3%
Synthetic Fibre ...	13,000	+14%
Others	20,000	−9%
	248,000	−3%

Reduced demand has caused producers to slow down operations and it is anticipated that this year's output, though 3½% higher than last year's, will at 255,000 tons be appreciably below the industry's present capacity. So far no new refining methods have been introduced which might substantially improve the economics of native ore refining. Retort distillation—the prevalent means of ore treatment—limits the degree of sulphur recovery and in view of the mounting cost of ore mining this severely handicaps all efforts to reduce the cost of production. This is becoming a matter of anxiety to the industry as despite the security which it enjoys under the agreement with consumers it can see two important developments in Japan which cannot fail to reduce the demand for refined sulphur. Last April the carbon disulphide industry completed its lengthy investigations into various aspects of sulphur recovery and it is now reported to be putting its findings into effect. Whilst it is not yet clear how extensively the economics will be applied there is little doubt of their mounting impact. The second factor is more positive and concerns the recovery of high purity elemental sulphur from oil refinery gases. This source is expected to contribute increasingly to Japan's sulphur supplies as on the basis of existing plans oil refinery capacity and petro-chemicals output are due to expand. For the present the domestic price is still the same as last year, but despite their greater costs the producers may have to make concessions to consumers who may be expected to seek lower prices as pressure of domestic demand recedes. Coupled with the widening gap between the cost of production and world prices, which would seem to preclude the re-entry on any substantial scale of Japanese sulphur on world markets, the industry views the future with concern. If a relaxation in the Government's restrictive import policy encouraged consumers to look to the cheap and abundant overseas supplies—notably the growing volume of readily accessible Canadian recovered sulphur—the present concern could give way to alarm.

Matsuo Mining Company. Retort distillation furnace battery (left). Refined sulphur after discharge.

The crucial factor is the absence of an efficient refining process even more than the heavy capital investment needed to modernise a larger proportion of the mining installations. A nucleus of the more efficient producers may be expected to maintain their position as effective suppliers to the home market; nevertheless, like other native sulphur ore producers notably Chile and Italy, the Japanese industry is now faced with the consequences of the world-wide abundance of cheap sulphur.

JEFFERSON LAKE SULPHUR COMPANY

In his annual report for 1956, the President, Mr. Eugene H. Walet, jnr., gives account of the company's peak sulphur sales, dividend payments, working capital and total assets which were at the highest levels on record. At the same time net profits and net earnings declined compared with 1955, which Mr. Walet attributes primarily to the reduction in the price of sulphur for export, to meet the competition of the other leading producers, and to the substantial increases in operating costs, principally wages, fuel and materials.

Production

There were no changes in the company's production facilities and the decline of 27,000 tons sulphur (5½%) compared with the previous year's peak output to 437,000 tons Frasch and recovered sulphur was not significant. Frasch sulphur operations at Long Point and Clemens domes resulted in output near maximum capacity while Starks dome recorded the largest drop in production (15%). During 1956 additions to dome installations were carried out at Long Point and notably at Starks, the gross value of which rose from $2.0 to $2.1 million, Clemens, plant to the value of $66,000 is under construction. Production of recovered sulphur at Manderson, Wyoming, based on the reduction of H_2S obtained from sour natural gas showed a slight increase over 1955. Details of production of the individual units were as follows:—

	1956	*1955*	*1954*
Clemens ...	115,000	124,000	96,100
Long Point ...	246,000	250,000	249,200
Starks	93,000	111,000	88,200
Manderson ...	19,000	15,000	—
	473,000	500,000	433,500

Sales and Shipments

During 1956 the company successfully met the most vigorous competition in the sulphur industry and sold and shipped a record total of 337,000 tons sulphur for its own account, which exceeds by 14% the previous record tonnage shipped in 1955. Under the company's agreement with Texas Gulf Sulphur Co., the company shipped 128,005 tons was shipped on their behalf from Long Point dome compared with about 115,000 tons in 1955. In addition to supplying the leading American companies in the chemical, fertilizer, petroleum an paper industries Jefferson Lake Sulphur reached important markets in the United Kingdom, Europe, the Far East, Australia and South America.

Liquid sulphur truck loading installation. New vat under construction right background.

Finance

The company's total income in 1956 reached the record total of $12,732,552 ($10,387,960 million in 1955) while the net profit, after making provision for State and Federal income taxes totalling $546,274 declined 9¼% to $1,607,786. Significantly total costs, including operating, selling and research expenses rose 20% to $9,074,339. In view of the anticipated capital requirements for the company's many projects, arrangements for a new loan of $5 million were concluded. Total dividends payments of over $1.2 million were the highest on record but the payment per share of 70 cents on preference stock and $1.60 on common stock remained the same as in 1955. Capital expenditure increased to $856,199 and total assets expanded 6% to $14.1 million.

Recovered Sulphur

The establishment of an Oil and Gas Division at Tulsa under Vice-President Harold W. Manley, emphasises the company's growing interest in this sector of industry. Following satisfactory operations in 1956 at the Manderson, Wyoming, sulphur recovery plant, an increase is expected in 1957 as the result of Mobil Oil, one of the operating companies, bringing a new sour gas well into operation. In Canada the company has concluded agreements with Pacific Petroleums Ltd., and Westcoast Transmission Co. Ltd., to process their

entire arisings of sour gas in British Columbia and it is envisaged that a sulphur recovery plant, built in conjunction with a gas cleaning plant at Taylor, will start operation late in 1957. Gas reserves in this area indicate a potential production rate of 100,000 to 200,000 tons sulphur annually for the next thirty years. A similar agreement was recently concluded with the Mobil Oil Co., of Canada under which Jefferson Lake will drill for natural gas and exploit over an 80,000 acre lease area in the Calgary District of Alberta. Three wells drilled by Mobil Oil show that there is a major reserve of sour gas containing about 12 long tons of recoverable sulphur per one million cu. feet of natural gas. Jefferson Lake are to start exploratory drilling work in the area and providing results bear out the preliminary investigations will proceed with the construction of a sulphur recovery unit with an initial capacity of 350 tons per day. According to Mr. Walet, it is thought likely that this area may prove to be one of the major sulphur deposits in the world. Progress is also reported on a pilot plant for the direct absorption of H_2S from sour natural gas.

Other Activities

Petro-chemicals: Following the purchase in 1956 of the outstanding shares of the Merichem Company, making it a wholly-owned subsidiary, it was merged with the parent company early this year and became its petro-chemical division. Cresylic acid and sodium sulphide are the main products and the division's activities promise to achieve significant expansions.

Research: The development and modifications of the experimental Rotasorber plant for the recovery of gasoline and other liquid petroleum gas is reported to be nearing a satisfactory conclusion.

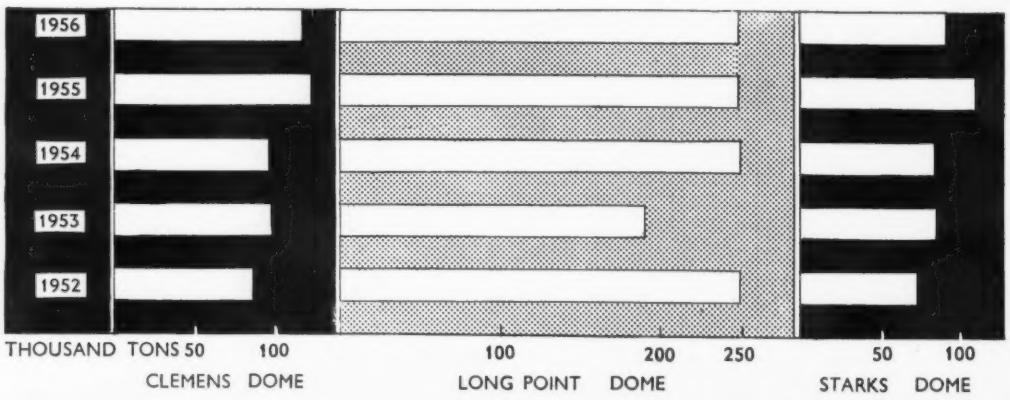
Similarly the development of the turbine submerged burner equipment is nearing completion. Designed to heat the large quantities of water needed for Frasch sulphur production it promises substantial savings in initial and subsequent operating costs and by recirculation of used water will recover any latent heat value. It is capable of operating with salt and brackish water. Final tests prior to its installation at Clemens Dome have been completed.

Conclusion

Although the company has lost the third place amongst the world brimstone producers, it has strengthened its long-term position by associations with producers of sour gas in Canada which promises to give Jefferson Lake over 300,000 tons new recovered brimstone capacity. Within the framework of the company's vigorous world-wide sales policy the disposal of the impending arising of recovered sulphur in Canada is receiving special attention.

Although sulphur remains the focus of its interests and is the main-stay of the company's income, the activities of the Merichem Company Division in petro-chemicals and of the Oil and Gas Division, both of which are reinvesting significant proportions of their profits, are assuming growing importance.

Summing up the company's progress in 1956 Mr. Walet said that " substantial progress has been made towards the company's ultimate objectives of increased sulphur production, of greater sales-over-all, with more emphasis on the domestic production, of diversification of the company's activities into the related natural resources fields of oil and gas development and petro-chemical development."



Current Events

AUSTRALIA

Titanium Dioxide and Ilmenite

Australian Titan Products Co., Ltd., a subsidiary of British Titan Products Co., Ltd., currently the only producer of titanium pigments in Australia, is engaged on a project which will raise the capacity of its pigments plant from 8,000 tons to 20,000 tons per annum. Located at Burnie, Tasmania, it is favourably sited in relation to shipping facilities, and it obtains its sulphuric acid supplies from the Electrolytic Zinc Company of Australasia Ltd., at Risdon. To this major by-product acid manufacturer the greater acid requirements of the pigments plant which on completion of the expanded project is expected to consume 25,000 tons per annum, represent a welcome new outlet. Two thousand five hundred miles to the west, at Bunbury, Western Australia, a subsidiary of another important United Kingdom producer of titanium pigments, namely *Laporte Titanium Ltd.*, is reported to be planning the establishment of a titanium oxide plant. As there does not appear to be any surplus sulphuric acid capacity it may be expected that if realised this project would comprise an integrated sulphuric acid plant.

The development of these domestic processing plants makes, however, little, if any, impact on the critical position of the beach sands industry, which is occasioned by oversupply. Rutile, hitherto the most important raw material for pigments production on account of its high TiO_2 content, is being challenged by the more prolific ilmenite, which is becoming available in increasing quantities not only in Australia where production capacity is about to rise to 300,000 tons annually, but also in many other countries.

At present, the largest Australian producer of ilmenite concentrates is Western Titanium N.L., at Capel, Western Australia, where the plant's capacity of 72,000 tons of concentrates is being raised to 100,000 tons annually. Not counting other major ilmenite projects, namely that of Consolidated Zinc Company in Queensland, other Western Australian expansion plans are considerable in that Messrs. Cable (1956) Ltd., operating on the shore of Koombana Bay, Bunbury, is to increase its capacity to 90,000 tons annually of concentrates, and Western Oil Ltd., have announced that they are to erect a plant to the south-east of Capel, Western Australia, with a capacity of 100,000 tons annually.

CANADA

New Liquid Alum Plant

The Nichols Chemical Company is at present building at Port Arthur, Ontario, a liquid aluminium sulphate plant which is due to enter production towards the end of this year. Situated in the centre of the important pulp and paper industry in the Lakehead area of Western Ontario, these liquid alum facilities will serve a region where further industrial growth is favoured by the imminent supply of natural gas, and the completion of the St. Lawrence seaway.

Nichols Chemical Company is the principal supplier in Canada of this important heavy chemical and the new installation will supplement production at the company's other recently completed plants located at Thorold, Ontario, and Barnet, British Colombia.

Large Sulphide Ore Body Discovered

Sharbot Lake Mines in the course of a diamond drilling programme on their property at Sharbot Lake in Older Township, near Perth, Ontario, have discovered an important sulphide ore body estimated at 10 million tons. Quality is reported to improve at depth, with assays on the deeper horizons of the ore zone running in the order of $20 per ton in combined, nickel copper and cobalt content. In view of the promising potentialities of the deposit, Mr. Dethier, the President, has signed a drilling contract bringing a third heavy drill into operation immediately on a programme to drill to depths of 4,000 feet. In due course development may be expected to include provision for the use of the substantial quantities of sulphur which should be recoverable as a by-product of the envisaged metallurgical operations.

Pipeline in Operation.

Westcoast Transmission Corporation has opened Canada's first long-distance natural gas pipeline. The necessary testing operations are being undertaken simultanously from the north and south ends of the pipe, and by

the beginning of September the area around Quesnel was receiving natural gas which soon after reached Vancouver. By the beginning of November, as scheduled, the entire pipeline will be in service, permitting exports to the United States through Pacific North West Pipelines Corporation to commence.

Built at a cost of $170 million the pipeline stretches from the Peace River gas fields, of Western Alberta and Eastern British Columbia, to Vancouver and the U.S. border, a distance of about 650 miles. Initial capacity is 400 million cubic feet of gas per day, and this is to be boosted to 660 million cubic feet of gas by five additional compressor stations. Gas cleaning operations and sulphur recovery has now started and the plant at Taylor, British Columbia, operated by the Jefferson Lake Sulphur Company is steadily raising its output to the planned daily rate of 300 tons high purity elemental sulphur which should be achieved by the end of the year.

UNITED STATES

Expansion of Liquid Alum Facilities

When, early this year the *General Chemical Division* of *Allied Chemical & Dye Corporation* started to produce liquid alum at Port St. Joe, Florida, it had in operation 24 plants situated in the major pulp and paper producing region in the United States. The company has now announced that construction of a liquid alum plant is to be started at Pine Bluff, Arkansas. This accords with the increasing use of the Southern pine stands and the expansion of the pulp and paper industry in the Southern States. The company's output of aluminium sulphate is in dry or in liquid form and whilst the pulp and paper industry is still the company's principal customer, there is a rapidly growing outlet in water purification.

New Acid Plants

The Chemical Construction Corporation is at present engaged in the construction of two major sulphuric acid plants which will have a combined daily capacity of 850 tons.

The *Stauffer Chemical Company* has commissioned a new plant to be built at Hammond, Indiana, which is to use sludge acid as a source of sulphur. This decision reflects the Company's policy of maintaining flexibility of operation and making use of the most economic form of local sulphur. The new plant, Stauffer's eighth acid regeneration unit to be built since 1946, will have a daily capacity of 400 tons (100% H_2SO_4) and will embody the latest features in automation. Similar to the Company's Houston installation it is designed to use all types of sludge acid from the heavy fractions containing very high percentages of hydrocarbons, down to the light ones. To the expanding oil refining industry in the Hammond-Whiting-Chicago area this development provides the solution of the effluent problem, and to Stauffer this new cheap source of sulphur supply offers an opportunity to strengthen its competitive ability and to extend its activities in this important area.

The *National Lead Company-Titanium Division*—at St. Louis, Missouri, has ordered a new sulphuric acid plant as part of the extension to the titanium pigment plant. The construction of a 450 tons per day (100% H_2SO_4) brimstone sulphuric acid contact unit is now in hand. The fifteenth plant built by Chemico for the National Lead Company, it is to be completed in March, 1958.

Development of the Gas Hills Area—Wyoming

Prompted by recently announced plans to increase production of uranium concentrates in the Gas Hills area, coupled with the increasing needs of new oil refining and chemical industries in the district, the town of Casper is becoming an important new centre of sulphuric acid manufacture.

The Platte Chemical Company has announced the construction of a 225 tons per day acid plant which is to cost about $2½ million. It is understood that contracts have already been concluded with local oil refineries for the purchase of sludge acid, which will be the principal sulphurous raw material. Construction work is well advanced on the 150 tons per day sulphuric acid plant of *Oil Incorporated*, and production is to start in January. The *Davison Chemical Company* is now engaged on the erection of a sulphuric acid plant which is due to start operations next summer. It will have a daily capacity of 200 tons acid (100% H_2SO_4), and is being built by the Leonard Construction Co. to the Monsanto design. The total cost of the project will be about $2½ million. A design feature of the plant is the burning of the

various raw materials directly in special nozzles which are inserted in a single horizontal combustion chamber. This permits the use of raw materials either singly or in combination, and gives the plant a wide degree of flexibility of operation. Elemental sulphur, which is to be purchased from several companies in the area recovering sulphur from natural and oil refinery sour gas, will be shipped to the plant in the molten state in steam-jacketed tank cars or truck. Spent alkylation and sludge acids will be obtained from local oil refineries. Output of 66° Bé virgin acid will be directed to uranium refineries, whilst the production of 98% acid as well as 20% oleum is to meet the needs of the oil refineries.

The anticipated increase in acid use by the uranium industry is occasioned by two new projects which are expected shortly to receive the sanction of the Atomic Energy Commission. They are two 1,000 tons per day uranium ore mills which Lucky McUranium Co., with the Pelps Dodge Company and Globe Mining Company with the Union Carbide Company are planning to build. At present the comparatively low level acid needs is met by supplies brought in from Denver, where the major supply is the Allied Chemical & Dye Corp., whose plant is based on by-product pyrites purchased from the Climax Molybdenum Company. By next summer, on completion of the three new acid plants, there would appear to be ample acid capacity in the area to meet the needs of new consuming industries, and to allow for some increase of consumption.

AUSTRIA

Oesterreichische Stickstoffwerke A.G.

A new sulphuric acid installation based on brimstone is now in regular production at this company's fertiliser plant at Linz. The converter, based on the contact process, has a maximum capacity of 75 tons per day (100% H_2SO_4) and it is served by a brimstone burner which has a consumption range of 10-25 tons per day. This plant is additional to the company's established anhydrite acid plant. The new brimstone acid plant draws its supplies from Mexico; the Pan-American Sulphur Company effected the first shipment in June when 1,524 tons were delivered via Bremen.

FRANCE

Sulphuric Acid Project

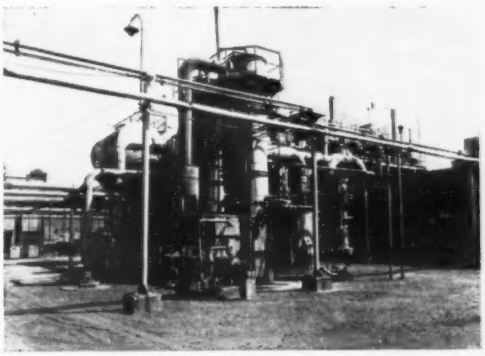
The new sulphuric acid plant now in an advanced stage of construction at Le Havre for *St. Gobain, Chauny & Cirey* is expected to commence operation in December of this year. The plant, engineered by the Company's staff, consists of two units each with a daily capacity of 120 tons (100% H_2SO_4). A notable feature is the installation of mixed burning facilities which enable brimstone to be used simultaneously or alternately with H_2S, which is supplied from a nearby oil refinery.

About 80% of the acid output will be delivered to the local titanium pigments plant of Les Produits du Titane. In view of growing acid needs in the area, partly for pigments production, St. Gobain already envisage the erection of a duplicate sulphuric acid installation.

GERMANY

Recovered Sulphur Production

In 1956 output of recovered sulphur in Western Germany totalled 78,364 metric tons. The extraction of elemental sulphur from spent oxide by means of carbon disulphide and in some instances trichlorethyline yielded 21,192 tons. Wet purification of coke-oven gases by way of H_2S and Claus kiln treatment yielded 15,143 tons. The balance of German production derives from H_2S contained in oil refinery gases from which it is extracted by the Amine process and converted into its elemental sulphur form in Claus kilns. It is significant that as much as 46.2% of the German output of recovered sulphur is derived from coal gas, the largest tonnage so recovered in the free world.



Scholven-Chemie A.G. Sulphur recovery plant.

SPAIN

Titanium Dioxide Pigments

Spain's principal producer of titanium dioxide pigments, *Union Quimica del Norte Espanola S.A.*, anticipate that production in 1957 will total 7,300 tons. The company's plant is located at Axpe-Bilbao and produces a wide variety of pigments which include titanium tetrachloride and butyl titanate. Ilmenite is obtained from their local mines and sulphuric acid from the company's recently modernised installations. Additions to the plant were completed in 1955 and raised its capacity to 36,000 tons (100% H_2SO_4). Construction work has commenced on an additional sulphuric acid plant, which will have an annual capacity of 54,000 tons (100% H_2SO_4), and which is primarily intended to meet the rising acid requirements for titanium dioxide pigments manufacture. UNQUINESA, one of the largest chemical firms in Spain, commenced titanium dioxide production in 1952, at an annual rate of approximately 1,000 tons and has constantly increased production. Chromogenia y Quimica Curtiente, S.A., at present the only other producers of titanium dioxide in Spain, has only a small production capacity and during 1955 its output totalled 300 tons. Production of pigments is readily consumed by the domestic market, and in view of growing requirements it may be difficult for the producers to maintain exports which in 1956 totalled 400 tons.

Sulphuric Acid, 1956

New sulphuric acid plant projects registered with the Instituto National de Industrias during 1956, raised the design capacity of all projects to 1.19 million tons (100% H_2SO_4) compared with 0.93 million tons in the previous year. Actual production during 1956 totalled 914,475 metric tons (100% H_2SO_4), an increase of 7¼% over the record production of 1955. During the year, new contact plants of S.A. Cros at San Juan de Aznalfarache, and Union Espanola de Explosivos at Los Milanos and Aldea Moret entered operation, while several plant modifications were carried out in order to raise capacity and to increase efficiency. Production capacity of contact installations during the year rose 11% to 365,000 tons, and that of chamber/tower plants by 1¼% to 744,000 tons, while the continuing heavy demand for acid resulted in a higher percentage of utilisation at 77% and 85% respectively.

The large number of contact acid projects, with an envisaged capacity of 1.06 million contrasts with the small number of chamber plants projects of only 136,000 tons.

Companies who have received planning permission this year for the erection of chamber acid plants are as follows:—

Company	*Location*	*Capacity 100% H_2SO_4 Metric Tons*
S. A. Cros	Badalona	14,000
S. A. Carrillo	Atarfe	5,840
Soc. Navarra de Industrias	Lodosa	25,000
Asturiana de Minas	Hinojedo	10,000
Union Espanola de Explosives	San Jeronimo	8,640

During 1956, projected additions to contact acid installations increased by 260,000 tons (33%). In addition to the following list of smaller installations, mainly intended to meet the growing needs of the fertiliser manufacturers, the petroleum refining industry has announced two projects which might be based on sulphur to be recovered in the refining of the sour crudes.

Company	*Location*	*Capacity 100% H_2SO_4 Metric Tons*
S.A. Cros	Alicante	18,000
Fab. Nac. de Colorantes y Explosives S.A.	Barcelona	15,000
Barrau S.A.	Mongat	10,800
Soc. Navarro de Industrias	Lodosa	11,000
S.A. Cros	Maliano	18,250

The largest sulphuric acid plant is for Compania Espanola de Petroles S.A., who are planning a plant with an annual capacity of 75,000 tons at Cartegena. The new projects are a further important step in Spain's sulphuric acid industry, which in recent years has assumed much prominence, principally on account of supplying an expanding fertiliser industry and a greater range of industrial needs, notably titanium dioxide, carbon disulphide, petroleum refining, iron and steel, and the pulp and paper industries.

U.S.S.R.

Sulphuric Acid

Production of sulphuric acid in the U.S.S.R. during the first six months of 1957 is reported to have totalled 2.58 million tons (100% H_2SO_4), 9½% more than in the corresponding period of 1956. Manufacture of fertiliser expanded 5½% to 5.7 million tons.

JAPAN

Expansion of Titanium Dioxide Capacity

Ishihara Sangyo Kaisha Limited, one of the most important manufacturers of titanium dioxide in the Far East, have recently completed additions to their plant at Tokkaichi, Mie Prefecture, which doubles its capacity to 24,000 tons per annum. The additional plant which went into operation early this summer employs parallel circuits, one treating rutile and the other anatase.

The company's sulphuric acid facilities consist of a Petersen Tower plant and an Osame contact plant, with daily capacities of 125 tons and 100 tons respectively. Built in 1941, they were supplemented after the war with a 120-tons-per-day contact plant, built by Chemiebau Dr. Zieren. All are based on the use of pyrite concentrates with an average of 47% sulphur. After the company's acid requirement for titanium dioxide, fertilisers and agricultural chemicals are met, a small quantity of acid is sold to local consumers.

Sulphuric Acid—January to June, 1957

Stimulated by the high level of industrial activity, production of sulphuric acid in Japan during the first half of this year, reached a record total of 1,966,361 metric tons (100% H_2SO_4). This level of operations represents nearly 95% of employment of installed capacity. The expansion of 174,000 tons (9¾%) resulted predominantly from greater contact acid output, which represented 61% of production compared with 57½% in the corresponding period of last year. The additions to non-ferrous smelting capacity and modernisation of by-product acid plants has increased output of by-product acid to a record annual rate of 0.55 million tons; this has been occasioned primarily by a 74,000 tons increase in contact acid output to 180,000 tons.

Of the total acid production 86% was based on the use of iron pyrites, pyrrhotite and sulphur ore. At 978,000 tons for the half-year, the rate of pyrite consumption was 11% greater than in the same period last year and pyrrhotite consumption also increased to 93,000 tons. Consumption of sulphur ore for acid manufacture, however, receded to 346,000 tons, 11½% less than the corresponding period last year. The use of zinc blendes and copper concentrates rose 9% and 118% respectively, the latter reflecting the increasing use of imported material from the Philippines.

Sulphuric acid consumption during the first half-year also rose to record levels, and totalled nearly 2 million tons. Although in the first half-year acid demand by fertiliser industry customarily exerts the stronger

Dowa Mining Company's by-product acid plant. Mist cottrells on left. Karbate cooler on right.

influence, the more significant progress has been made by industries which are less subject to seasonal variation, notably the synthetic fibre industry, inorganic chemicals, iron and steel, and the petroleum industries.

The principal consumers of sulphuric acid are as follows:—

	000 Metric Tons 100% H_2SO_4	
	January-June	*January-June*
	1957	*1956*
Nitrogenous fertilisers	835.5	842.7
Phosphatic fertilisers ...	458.5	458.7
Synthetic fibres ...	268.0	208.7
Inorganic Chemicals ...	120.7	81.3
Organic Chemicals ...	43.0	11.2
Iron and Steel	40.0	29.7
Petroleum	36.7	26.2
Dyestuffs and Intermediates	19.3	42.7
Metal Industry ...	17.0	14.7
Pulp and Paper ...	14.7	11.6
Other	115.9	102.7
	1,969.3	1,829.9

The slight reductions in sulphuric acid needs for the fertiliser industry are understood to be a temporary feature which has little effect on the envisaged expansionist trend of this sector of the sulphur industry. Over-production in the man-made fibre industry, however, has since August resulted in a reduction of activity, and in consequence lower acid demand. The immediate effect of the Government attempt to enforce a dis-inflationary policy and to curb imports, is likely to slow down investment and the rate of growth of industrial activity, the effect of which will be reflected in the second half-year results of the sulphuric acid industry.

Appendix A

Approved Uranium Producers in South Africa

MINING COMPANY	*LOCATION OF URANIUM PLANT*	*DATE OF COMMENCEMENT OF PLANT*
West Rand Consolidated Mines Ltd.	West Rand Cons.	October 1952
Daggafontein Mines Ltd.	Daggafontein	April 1953
Blyvooruitzicht G.M. Co. Ltd.	Blyvooruitzicht	April 1953
Western Reef Explor. and Devel. Co. Ltd.	Western Reefs	September 1953
Stilfontein, Ellaton, Afrikander Lease, New Klerksdorp, Babrosco	Stilfontein	September 1953
Randfontein Estates G.M. Co. W. Ltd.	Randfontein	February 1954
East Champ d'Or G.M. Co. Ltd.		
Luipaards Vlei Estate and G.M. Co. Ltd.	Luipaards Vlei	November 1954
Vogelstruisbult G.M. Areas, Ltd.	Vogelstruisbult	December 1954
President Steyn G.M. Co. Ltd., President Brand G.M. Co. Ltd., Free State Geduld Mines Ltd., Western Holdings Ltd.	President Steyn	January 1955
Welkom G.M. Co. Ltd., Freddies Consolidated, Loraine G.M. Co. Ltd.	Welkom	January 1955
Harmony G.M. Co. Ltd.	Harmony	March 1955
Dominion Reefs (Klerksdorp) Ltd.	Dominion Reefs	June 1955
Virginia O.F.S.G.M. Co. Ltd., Merriespruit (O.F.S.) G.M. Co. Ltd.	Virginia	September 1955
Vaal Reefs Explor. and Mining Co. Ltd.	Vaal Reefs	May 1956
West Driefontein G.M. Co. Ltd., Doornfontein G.M. Co. Ltd.	West Driefontein	September 1956
Hartebeestfontein G.M. Co. Ltd.	Hartebeestfontein	October 1956
Buffelsfontein G.M. Co. Ltd.	Buffelsfontein	July 1957

Statistical Appendix

United Kingdom

IMPORTS JANUARY-JUNE, 1957 — LONG TONS

SULPHUR		*SULPHUR WASTES AND RESIDUES **		*PYRITES*	
Belgium	48	United States	5,926	Cyprus	90,412
France	38			Canada	9,802
United States	136,045			Portugal	5,019
Mexico	28,527			Spain	48,206
TOTAL	164,658		5,926		153,439

* Wastes and residues of which uncombined sulphur constitutes not less than 70% of the dry weight.

Holland

IMPORTS JANUARY-JULY, 1957 — METRIC TONS

PYRITES	*Jan-June*	*July*	*SULPHUR*	*Jan-June*	*July*
Portugal	38,973	—	West Germany	757	57
Sweden	4,728	—	Mexico	2,994	11,900
Spain	73,340	15,338	Belgium/Luxemburg	127	28
Cyprus	42,112	8,636	Great Britain	4	—
Norway	5,026	—	Others	69	—
Others	4	1			
TOTAL	164,183	23,975		3,951	11,985

Japan

SULPHURIC ACID PRODUCTION

Thousand Metric Tons 100% H_2SO_4

Acid produced from	*Jan.-June 1957*			*Jan.-June 1956*		
	Chamber	*Contact*	*Total*	*Chamber*	*Contact*	*Total*
Zinc Smelter Gases	25.4	86.5	111.9	30.2	68.8	99.0
Copper Smelter Gases	71.2	93.6	164.8	74.4	47.7	122.1
Pyrites & Sulphur Ores	672.9	1,016.7	1,689.6	655.7	915.8	1,571.5
Total	769.5	1,196.8	1,966.3	760.3	1,032.3	1,792.6

Mexico

SULPHUR EXPORTS, April-June, 1957

Metric Tons

	Pan American Sulphur Co.	*Gulf Sulphur Corp.*	*Total 2nd Qtr.*	*Total Jan-June 1957*
U.S.A.	79,446	36,660	116,106	225,929
Australia	9,429	13,146	22,575	41,853
New Zealand	19,565	——	19,565	19,565
Belgium	12,343	——	12,343	12,343
France	13,919	——	13,919	37,127
Holland	16,952	1,221	18,173	19,687
United Kingdom	13,714	3,048	16,762	36,779
Western Germany	——	813	813	2,191
Tunisia	3,258	——	3,258	3,258
Total :	168,626	54,888	223,514	398,732

United States

SULPHUR EXPORTS

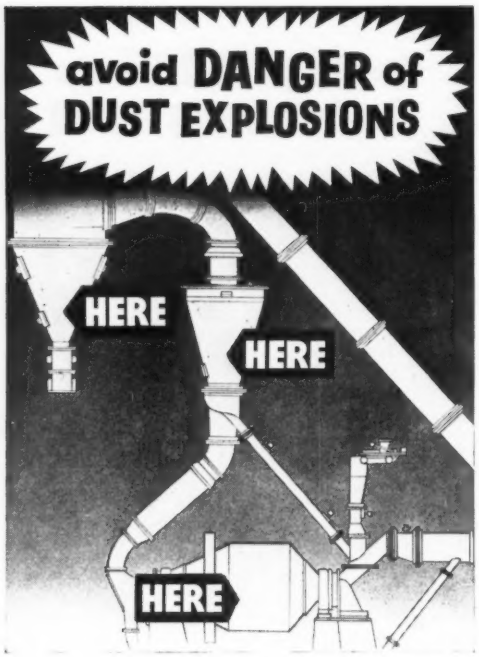
LONG TONS

	2nd Qtr. Total	*Jan.-June Total*		*2nd Qtr. Total*	*Jan.-June Total*
Canada	112,006	129,008	Yugoslavia	2,000	2,000
Cuba	2,400	8,643	Canary Islands	—	3,989
Brazil	31,475	55,739	India	29,800	62,420
Argentine	14,508	22,409	Australia	11,650	24,125
Uruguay	3,050	3,050	New Zealand	23,850	31,655
United Kingdom	63,980	129,979	Algeria	4,271	8,271
W. Germany	22,495	33,545	Morocco	—	4,000
France	31,900	66,100	Tunisia	4,000	4,000
Austria	5,200	9,200	Union of South Africa ...	21,000	51,350
Switzerland	21,816	21,816	Other Countries	4,561	15,195
Finland	8,820	8,820			
Sweden	5,950	5,950			
Belgium	30,150	43,700	Total	457,382	747,464
Netherlands	2,500	2,500			

SULPHUR PRODUCTION

	PRODUCTION		*STOCKS*		*EXPORTS*	*IMPORTS*
	Frasch	*Recovered*	*Frasch*	*Recovered*		
1953	5,155,342	337,099	3,022,486	107,344	1,241,536	
1954	5,515,543	357,400	3,228,020	109,066	1,647,011	1,104
1955	5,743,344	401,650	3,181,198	120,267	1,595,419	38,317
1956	6,427,229	480,980	3,936,450	119,446	1,651,597	203,300
1956 April	504,289	36,200	3,240,373	118,760	117,072	20,119
May	543,217	38,500	3,276,638	113,377	131,049	10,025
June	565,002	38,200	3,330,433	111,945	157,940	12,437
July	621,130	43,400	3,493,942	115,246	136,048	15,036
August	597,699	42,500	3,636,730	115,047	188,240	15,347
September	524,370	42,000	3,680,784	117,759	138,784	28,440
October	529,056	40,750	3,705,626	118,937	192,332	23,814
November	514,772	39,580	3,852,028	119,157	95,003	19,254
December	534,088	43,750	3,936,450	119,446	148,367	20,644
1957 January	495,353	42,154	3,997,911	118,296	115,747	33,883
February	439,997	39,000	4,087,925	116,713	74,698	29,141
March	471,548	39,800	4,102,394	111,905	99,637	44,673
April	461,589	37,650	4,049,025	122,006	171,258	43,897
May	429,227	42,400	4,092,772	127,908	113,147	39,847
June	439,513	44,867	4,086,614	144,753	172,977	

Official Bureau of Mines Data (long tons of 2,240lbs.)



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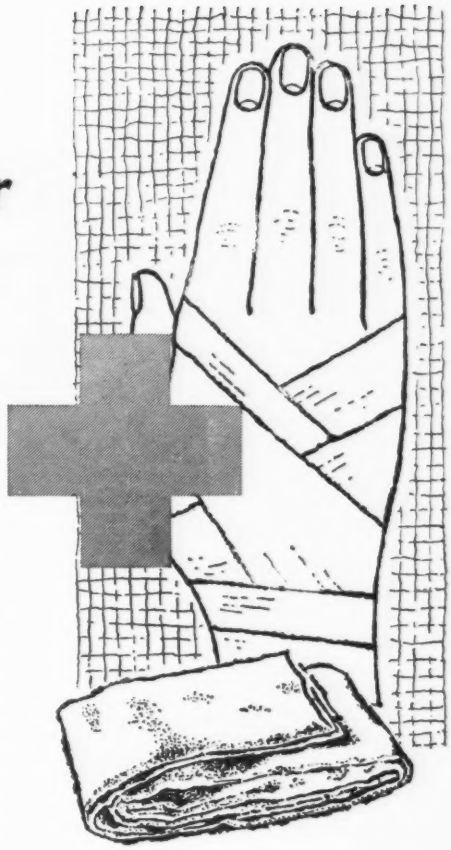

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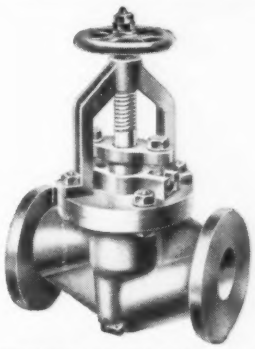

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